



Smart City
MISSION TRANSFORM-NATION

Integrated Command and Control Center

Maturity Assessment Framework and Toolkit

Draft version 1.0

**Ministry of Housing & Urban Affairs
(MoHUA)**

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***Maturity Assessment Framework and
Toolkit to unlock the potential of Integrated
Command and Control Centers (ICCCs).***

*Maturity Assessment Framework guidance document is a toolkit to assess the maturity of ICCC as an infrastructure. This framework aims to help Smart Cities optimize their ICCC investment through **do-it- yourself** assessment to identify gaps under functional, technological and governance aspects of ICCC.*

Disclaimer: This is confidential working paper and hence it represents work in progress concept. It is not meant to represent the position or opinion of Ministry of Housing and Urban Affairs, nor the official position of any staff members. Documents is circulated only to seek feedback and suggestions over the draft concept framework.

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1.Foreword

India is urbanizing exponentially with the expected influx of over 400 million people over next 35 years. This rapid urbanization presents a great opportunity for India to leapfrog stages of development, and at the same time address the chronic urban challenges. Rate of development of urban infrastructure in India has lagged population growth resulting in demand and supply gaps across sectors such as water, waste management, energy, mobility, the built environment, education, healthcare and safety.

Government of India, recognizing these challenges and opportunities, launched the 100 Smart Cities Mission in June 2015. Since the launch of the mission, 100 smart cities have been identified and cities have started executing civic infrastructure and ICT projects as per mission guidelines. Cities have conceptualized projects which enable them to do more with less, enhance their operational efficiency, and deliver timely and quality services to citizens.

In order to do more with less, cities are looking around for ground breaking technology interventions to manage the demand of exponentially growing population in cities (also attributed due to migration from rural areas for better economic opportunities) to bring in efficiency and optimization for providing better living environment to its inhabitants. Integrated Command and Control Centre platform equips cities to do more with less by graduating to real time data driven decision/policy making with better situational awareness as compared to traditional inefficient silo-ed departmental approach of city administration. Integrated Command Control Centre also reduces the complexity of dealing with multiple systems/application in different technologies using different platform by integrating them to common platform to leverage the intelligence for making informed decisions. Such effective Integrated Command and Control Centers will become an integral part of India's cities by sustainably addressing the need of 400 million urban dwellers who set to get urbanized over a span of next 35 years.

The Integrated Command and Control Center (ICCC) acts as the “nerve center” for operations management, day-to-day exception handing and disaster management. It also provides insights by processing complex data sets at an aggregated level to derive

intelligence for improved planning and policy making. The ICCC is envisaged to aggregate information across multiple applications and sensors deployed across the city, and then provide actionable information with appropriate visualization for decision makers. While few cities have started deploying ICCC under Smart Cities Mission with the requisite applications, network and sensors, they are at various stages of maturity as far as informed decision making is concerned. As these ICCCs are implemented it becomes imperative to gauge maturity of effectiveness using a standard methodology across the country so that investments made by cities yield commensurate benefits for cities and citizens in future.

The objective of this assessment framework is to provide cities a do-it-yourself toolkit to measure maturity and effectiveness of Integrated Command and Control Center in civic operations management, day-to-day exception handling, disaster management, planning and policy making. This toolkit intends to assess and enable cities that have invested in Integrated Command and Control Centers to make mid-course amendments to enhance effectiveness. For cities which are yet to commence implementation of ICCC, this maturity assessment will provide a frame of reference for a robust implementation which addresses people, process and technology dimensions of an effective Integrated Command and Control Center.

Core Objectives: ICCC Maturity Assessment Framework

Integrated command and control center maturity assessment framework is conceptualized to achieve the following objectives:

- A) To **leverage true potential** of command and control center platform.
- B) **Maturity assessment** of command and control center platform components (functional, technology and governance)
- C) To create knowledge exchange for **peer to peer learning** for designing innovative impactful use cases over ICCC platform
- D) Impact assessment of ICCC platform on improving **City livability indicators.**

2. Setting the Context

2.1 Why Integrated Command and Control Center?

The Integrated Command and Control Centers are envisaged to be the **brain** for city operation, exception handling, and disaster management. The sensors and edge devices will capture and generate real time data from various utilities such as water, waste management, energy, mobility, the built environment, education, healthcare and safety. ICCC as a platform through its different layers and components will act as a **decision support system (DSS)** for city administration to respond to the real time events by consuming data feeds from different data sources and by processing information out of the data sets.



The ICCC will be used for:

- Increasing the **situational awareness** by providing insights using data for civic officials across urban functions through deployment of sensors across the city.
- **Standardizing response protocol** at city level through institutionalization of standard processes for recurring events, issues and exigency scenarios.
- **Enhancing collaboration** across multiple departments within and outside urban local bodies and government bodies.
- **Institutionalizing data driven** decision making for regular operations and during crisis situation across levels of city functionaries – right from operators to city administrators.
- **Engaging** with on field support staff to address civic issues and citizen grievances.

Case Study: Integrated Command Control Center



Rio Operations Center, Rio De Janeiro, Brazil

- The Rio Operations Center's responsibility is to control the city's daily operations, integrating several departments involved in Rio's routine; and to manage crisis and emergency situations. Traffic emergency time response has been reduced significantly with citizens alerted about traffic snarl ups and accidents and redirected to the best routes.



Integrated Centre for Security and Emergency in Madrid

- Because of insight generated by a comprehensive,real-time view of events across the city, emergency managers can better assess needs, prioritize and coordinate actions, and proactively deploy assets to address—and potentially prevent—multiple, complex incidents



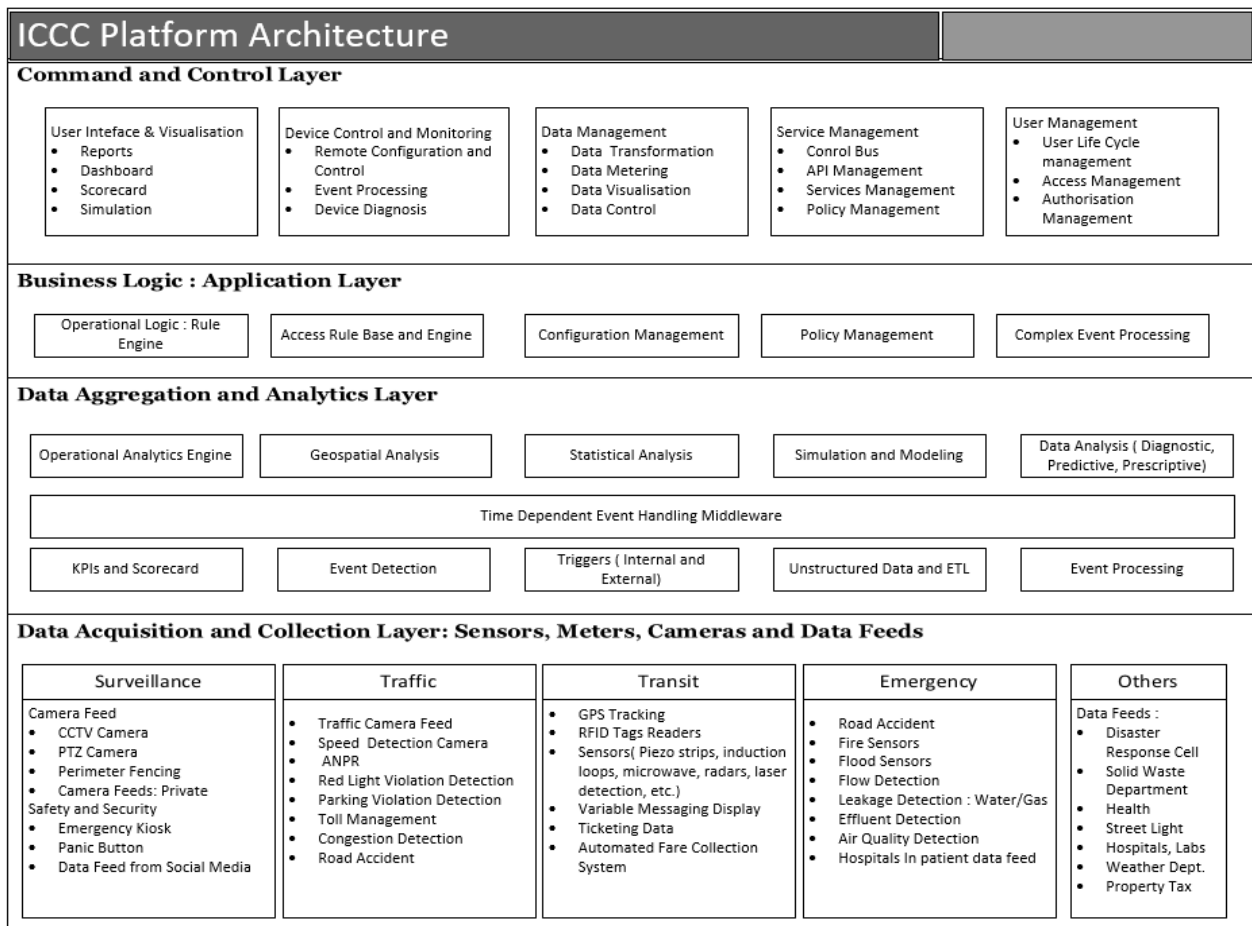
Surat SMAC, Gujarat

- This center collects functional information of all the departments and public on a real-time basis. Automated sensors and systems send various data sets to the SMAC, which are analyzed to avail important information to make decisions. All the online applications and mobile applications of SMC for people-centric services would be monitored from one place at the Smart City Centre.

Refer Detailed Case Study in Annexure I

2.2 ICCC architecture

A holistic ICCC platform will basically include four layers in the system, as mentioned below:



The **Data Acquisition Layer** consumes real time data from sensors devices, data sources, static and real time data feeds from different applications, systems and databases etc. for air and water quality monitoring, ambient light sensors for street light management, metering devices, telematics and location based devices, proximity sensors, surveillance and safety cameras, sensors for disaster detection, level sensors for solid waste management etc.

An ICCC can either collect data from sensors or process the same to generate information from the data collected and aggregated through its various components to generate alerts,

or it can connect to COTS and bespoke applications so that alerts generated by the integrated COTS/bespoke application/systems.

This layer enables other components of ICCC to aggregate, consume and process the data for deriving information.

The **Data Aggregation and Analytics Layer** is responsible for deriving information and intelligence from data captured from various data sources through data acquisition layer. **Data Aggregation and Analysis** comprises of components for extraction and transformation of data from different systems, data sources and different data formats. For ex: Health records are captured from Integrated Hospital Management System ,traffic information is captured from Adaptive Traffic Management System and Ambulance could be tracked using Vehicle Tracking system in different formats. ICCC Data aggregation and Analysis Layer is able to process the information and allows users to use information from different systems as per requirements.

Data Analytics components are used to perform data churning to derive intelligence from different data sets across the domain. This intelligence can then be used for exception handling and visualization in different scenarios through various analysis using ICCC components or third party tools/applications:

- a) Predictive Analytics
- b) Diagnostic Analytics
- c) Prescriptive Analytics
- d) Sentiment Analytics
- e) Video Analytics

This layer enables ICCC to derive intelligence from the information collected from Data Acquisition and Collection Layer.

Business Logic Application Layer is the core application engine of the ICCC platform which help end user to design and configure standard operating procedure, manage external and internal trigger, policy implementation, and handling complex events. Application layer also helps ICCC to handle events in real time complimenting it with

intelligence and information from various systems. Application layer also manages the response in different situations as per configured business logic.

It helps in configuring or automating the operations in different scenarios, for e.g.:

- a) Defining and configuring Event
- b) Defining and configuring External/ Internal Trigger
- c) Defining and configuring Event Response
- d) Defining and configuring responsibility matrix
- e) Defining and configuring incidents and change requests
- f) Defining and configuring user access and authorization
- g) Defining and configuring access policy of field assets

Application layer at ICCC allows to communicate with different systems. Few similar examples are mentioned below:

- i) Configuring Events and Response for Water Supply operations :
 - a. Configuring alerts and notification using Smart metering for water usage/consumption
 - b. Configuring Events and Trigger over data emanating through SCADA system for managing water operations
 - c. Configuring response protocol in case of leakage detection and
 - d. Configuring response protocol in case of effluent detection etc.
- ii) Event and Response Management for Waste Water Treatment
 - a. Configuring alerts and notification using SCADA for waste water treatment systems for its on field employees
 - b. Configuring alerts and notification using for level detections at treatment plant
 - c. Configuring Events and Trigger for managing energy consumptions of pumping control systems for storm water management

This layers enables ICCC to handle the events to make real time decisions as per the configured protocol.

Command and Control layer of ICCC is responsible for managing

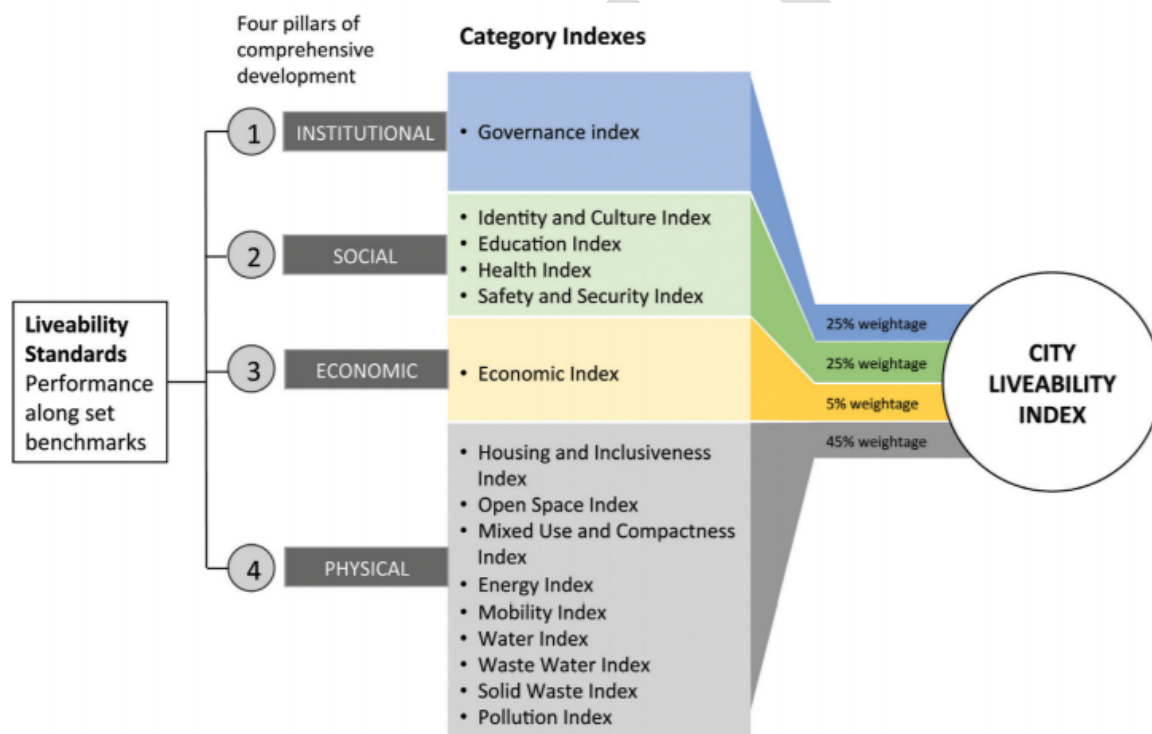
- a) Communication with Stakeholders
- b) Device Control (asset, access and authorization)
- c) User Interface and Visualization
- d) Complex Real Time Event Handling
- e) Service Management

The **command and control layer** will house the action oriented SOP's, incident response dispatches and management systems (rules engines, diagnostics systems, control systems, messaging system, events handling system), and reporting / dashboard system to provide actionable information to city administrators and citizens. While this layer will exist in most Integrated Command and Control Centers from inception, it will be flexible to accept inputs from various downstream applications and sensors as and when they get introduced in the city.



3. MoHUA Livability Index @Smart Cities

The Government of India, with support from various State and Local bodies, is running several flagship programs for urban development. With the purpose of making Indian cities more livable, MoHUA had launched one such initiative of ranking cities using a livability index which measures parameters across urban domains. All cities are striving to achieve a good score on this index, which gauges the quality of life for the citizens through improvements across multiple dimensions like housing, transportation, utilities, mobility, ICT, health, education, economy, etc.



The index is based on a set of 'Livability Standards in Cities, the source of which are the 24 elements contained in the Smart City Proposals (SCPs), which have been grouped into 15 categories. These categories are part of the four pillars of comprehensive development of cities. A total of 79 Indicators (57 Core Indicators and 22 Supporting Indicators) have been prescribed where while the Core Indicators are considered an essential measure of livability of cities, the Supporting Indicators supplement the Core Indicators by adding value to them. These are organized in 15 'Categories'. Sub-Indexes will be developed for

each of the categories to form 15 ‘Category Indexes’, which will be aggregated to a common ‘**City Livability Index**’ for each city on the 79 indicators.

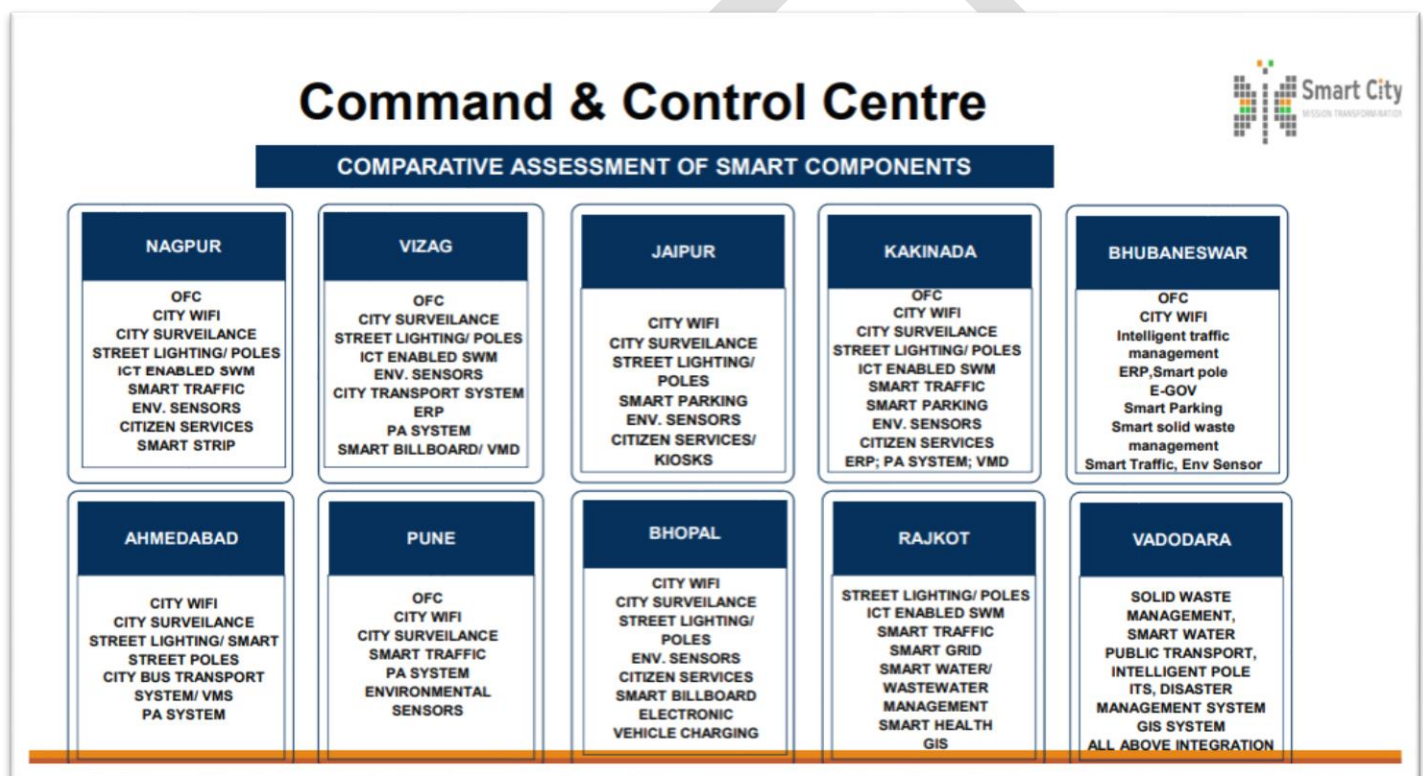
The Integrated Command and Control Center, if operationalized and managed successfully, can play a pivotal role in improving the livability of a city by ensuring efficient service delivery and quicker response to emergencies/crisis situations/hazards. It will in turn assist in improving the benchmark scores of cities on livability index by enhancing the monitoring of city services, data collection and analysis, based on which the ULBs can make informed decisions leading to better quality of life for the citizens.

Efficiency in Operations	Understand efficiency in the way resources are used and consumed over a period of time
	Understand efficiency of municipal employees/contractual deployed for managing city operations
	Understand financial efficiency of other urban interventions through measurement of improvement across urban domains facilitated through availability of data and video evidence pre and post implementation
Improvement in Quality of Life	Improvement in service delivery of municipal services (certificates, licenses) and grievance redressal
	Improvement in urban utilities & services such as water, waste water treatment and storm water management; waste management; street light etc.
	Improvement in civic infrastructure such as housing, roads, bridges, parks, garden, swimming pool and libraries etc.
	Improvement in urban transportation across different modes, and traffic conditions in the city.
	Improvement in safety, health and education indices in the city.
	Improvement in city environment in terms of quality of air to breathe, quality of water for civic consumption, and pollution free lakes, river and civic open areas.

Hence, it is imperative that the functions and operations of the ICCCs are aligned with key performance indicators as defined under Livability Indicators that capture the extent and quality of infrastructure, service delivery (water supply, SWM services, healthcare, e-Governance, etc.), and emergency response services.

How Cities are doing it today in our Country?

More than 11 cities have already set up their ICCC with an overall investment of 1550 Crore. Further 28 cities have started work on setting up of such centers and 22 more are in the advanced stage of pre- work preparation.



The real value of Integrated Command and Control Center lies in optimizing city operations and making informed decisions. Additionally, there is no uniformity in the implementation models that are adopted around the country. In many cities, departments/ organizations have decided to set up their own Command and Control Center to deliver one particular function (for instance using Command and

Control Center for the police to look after safety and security or to manage water related function) whereas on the other hand select cities have aggregated entire city operations under an Integrated Command and Control Center. While the city may chose the hub and spoke model or integrated model based on the way ULB functions are organized, it is important that the Integrated Command and Control Center is used for viewing, correlating, commanding and controlling city operation – including day-to-day scenarios and use case and exception management.

4. Need for ICCC assessment

Significant investment has been made for these facilities; however they are yet to be hardwired into day-to-day urban management functions of the urban local body. In the absence of a best operational model to look up to and lack of guidance available on the service integrations, there seems to be a wide-spread ambiguity amongst the executed ICCC projects regarding where they are standing currently and the goal they are aiming to achieve.

The assessment model provides a simple form of benchmarking the ICCC ecosystem in Smart cities across the country. These benchmarks would be running in parallel with the livability standard and categories of indicators and will further cover the essential aspects of an ICCC that is optimized in terms of the utilization of the governance, and technology framework to help make the city more livable and developed.

Further, the assessment will allow smart cities to gauge the maturity level of the existing ICCCs investment and identify areas where improvements are required. It will also act a launch pad for the cities which are yet to commence their city operations and system integrations.

The assessment shall enable cities to understand the impact of ICCC over following parameters connected with livability indicators and identify how urban operations have improved over a period of time – over and above traditional way of operations management.

In order to drive the return on investment from ICCCs infrastructure, we will need to assess the current maturity level of the individual function/use-cases/services and

identify the gaps and address them to ensure proficient delivery of city services. **We intend to find answers to following question through assessment activity:**

Functional

How effectively are we managing civic functions/utilities through ICCC platform ?

How effectively are we managing civic mobility through ICCC platform ?

How effectively are we managing safety and security operations/utilities through ICCC platform ?

How effectively are we managing Emergency situation through ICCC platform ?

How effectively are we able to ensure convergence of applications/systems/databases through ICCC platform ?

Governance

Are we equipped with required Policy framework to manage the civic operations through ICCC ?

Do we have required manpower to man ICCC operations to manage complex events in real time ?

Do we have responsibility matrix in place ?

Do we have Business Continuity plan in place to deal with operation disruptions ?

Technology

What is maturity level in terms of leveraging key components of ICCC platform ?

Are we leveraging all available components of ICCC Platform/Product ?

Are we able to put technology to use for managing city operations for improving Livability indicators ?

Are we able to effectively customise the platform as per city requirements ?

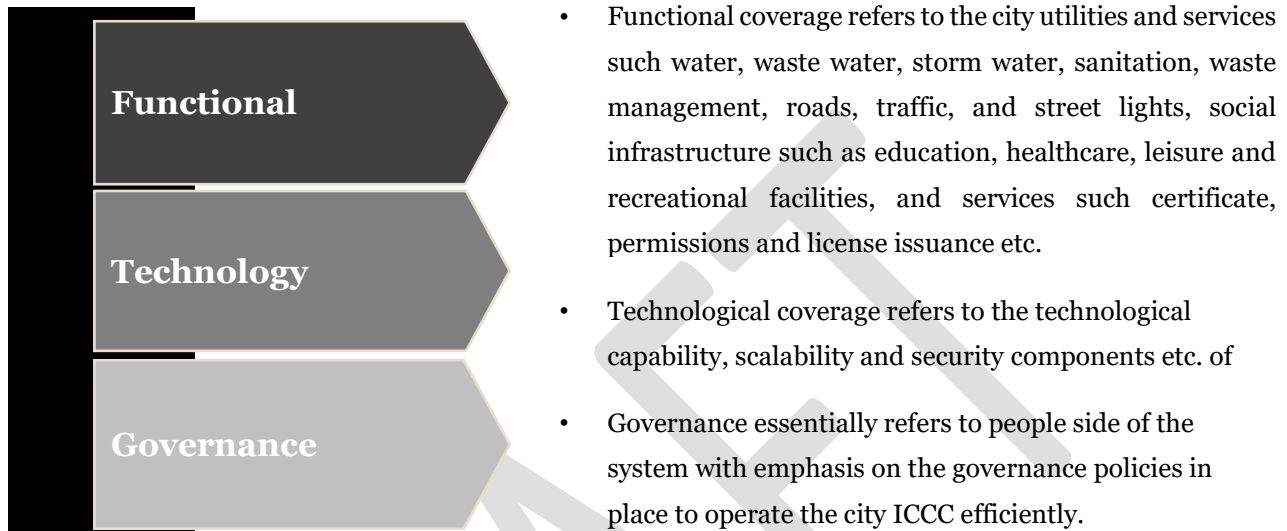
Digital maturity assessment framework and toolkit is explained in next section.

ICCC Maturity Assessment Framework and Toolkit: Explained

Digital Maturity Assessment Framework and Toolkit is explained in detail to assess the maturity of ICCC over Functional, Technical and Governance dimensions.

5. ICCC Maturity Assessment Framework

ICCC Maturity Assessment Framework assesses the ICCC ecosystem on the following dimensions:



Maturity Framework assesses the level of maturity of above mentioned components through a detailed questionnaire to understand how effectively the city has leveraged the capabilities of Integrated Command and Control Center to improve its day to day operations, policy and decision making. Maturity Framework would also help cities in identifying the implementation, technological and operational gaps under various smart solution projects so that Integrated Command and Control Centre could achieve its true potential.

Maturity Assessment Framework would also expose cities to various possibilities of efficient and effective urban governance which impacts day to day life of its citizens and officer managing the infrastructure/utilities operations. ICCC effectiveness would be gauged through functional use cases like Water Supply/ Solid Waste/ Civic Services/ Emergency Management etc. Objective is to focus on functional aspect of governance through ICCC with objective of bringing all civic bodies operations under one roof to achieve efficiency and effectiveness through standardization, achieve better situational awareness for bringing in optimization, and reduce human touchpoints in providing

response and developing capability to manage complex situations in real time through ICCC. Assessment model framework is explained below:

Parameter	Description	Components
Functional Capability	<p>Functional capabilities of ICCC would be assessed by measuring the maturity of given functional use case on ICCC capabilities.</p> <p>For instance - Is ICCC able to activate the pumping station based on increase in water levels?</p>	<p>Use Cases Categories :</p> <ul style="list-style-type: none"> • Civic Utilities <ul style="list-style-type: none"> a) Water b) Solid Waste c) Sewerage & Drainage d) Roads e) Street Light f) Property Tax • Mobility Services <ul style="list-style-type: none"> a) Public Transport b) Traffic c) Public Parking d) Public Cycle Sharing • Safety and Surveillance • Emergency and Crisis Management • Convergence <ul style="list-style-type: none"> a) ERP b) GIS c) Call Center d) Notification Gateway e) Mobile Apps f) Websites g) Messaging Display h) Public Address System <p>Each use case would be assessed over all four capabilities (visualization, analytics,</p>

		<p>communication and control) and score would be assigned to each use case.</p> <ul style="list-style-type: none"> • High maturity- 3 marks • Medium maturity- 2 marks • Low maturity -1 marks
Technical Capability	<p>Technical Capability of ICCC would be assessed by measuring if given ICCC product platform components are leveraged by given organization.</p>	<ul style="list-style-type: none"> • Sensor Integration for data acquisition and aggregation from edge network in city. • Network layer • Data center layer • Applications layer • Data Analytics and Co-relation layer • Command Control layer • Service delivery layer • Security layer <p>Maturity of each parameter would be assessed and score would be assigned as follows :</p> <ul style="list-style-type: none"> • High maturity- 3 marks • Medium maturity- 2 marks • Low maturity -1 marks
Governance Capability	<p>Governance Capability of ICCC ecosystem would be assessed by measuring the capability of key parameters with respect to ICCC to ensure smooth operations of ICCC.</p>	<ul style="list-style-type: none"> • Integrated Command and Control Center governance covering etc. • Resourcing and staffing • Field force management • Decision making framework <p>Maturity of each parameter would be assessed and score would be assigned as follows :</p>

		<ul style="list-style-type: none"> • High maturity- 3 marks • Medium maturity- 2 marks • Low maturity -1 marks
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Assessment approach and scoring for each components are explained in detail in next sections.

6. *Maturity Assessment Process*

Maturity Assessment Process: ICCC Maturity Assessment process is a three step process which covers the following steps:

Stage I: Self-Assessment Criteria

- Cities would be required to submit Maturity Assessment along with evidence over functional, technical and governance components.
- Only Cities which clears minimum threshold score would be eligible for Third Party Audit Process.
- Time Duration : With in 6 Months



Stage II: Third Party On-Site ICCC Maturity Assessment

- Third Party Assessment would be required to audit Integrated Command Control Center Maturity as per Self Assessment submitted by City SPV.
- Third Party would be identified and engaged by Ministry of Housing and Urban Affairs, GoI
- Timelines : With in 60 days of submission and acceptance of Self Assessment



Stage III: Maturity Assessment Certification

- Cities ICCC would be mapped onto following Maturity Levels
 - Level 1 : Enabled
 - Level 2 : Established
 - Level 3 : Leader
 - Level 4 : Lighthouse
- This Assessment would be done as per defined functional use cases as per city readiness.

6.1 Stage I: ICCC Maturity Self- Assessment Toolkit Explained

Under Self-Assessment stage, cities would be required to assess and submit assessment over following components of Integrated Command Control Centre:

- a) Functional Capability
- b) Technology Readiness
- c) Governance Capability

Evaluation criteria for above mentioned components are explained below:

I. ICCC Functional Capability Assessment

The first component of the framework is assessing functional capability of ICCC i.e. the civic utilities or services being monitored by either the system or the people deployed at the facility. This shall include the services which are supposed to get integrated with the ICCC and covers the primary services given out by the cities:

- a. **City Utilities and Civic Services:** These primarily include civic services provided by the urban local body (ULB) to cater to daily needs of publicist citizens in general. The framework considers that a city ICCC must integrate & monitor these services at its facility as any disruption in the services and lack of timely response could lead to poor service delivery. Few basic utilities managed by ULBs are as follows:
 - a. **Water Supply and Waste Water Management:** The water supply and its quality treatment is done by ULBs. Waste water treatment operations also managed by ULBs.
 - b. **Solid Waste Management:** This includes services like residential garbage collection, construction and debris collection, and recycling of the waste collected and disposal on daily basis
 - c. **Smart Street Lighting Management:** This refers to the management of network of street lights installed across city limits to ensure safe streets.
 - d. **Environment:** It refers to the various sensors installed across city to monitor data from sensors like pollution sensors, noise sensors, light sensors, etc.

- b. **City mobility services:** These services refer to connectivity services provided by the city for public to travel from one point to another. It includes provision of connectivity, accessibility and also public space for parking of vehicles. The three broad domains can be listed as below:
- a. **Transit Management (connectivity):** It refers to management of public transport vehicles like buses, taxis, and trains etc. which assist public in connecting to various parts of the city.
 - b. **Traffic Management (accessibility):** This refers to the planning & control of transport services across city to manage the traffic flow within the city.
 - c. **City Parking Solutions:** It refers to the management of public parking spaces in terms of usage as well as revenue collection.
- c. **Safety and Security:** Primarily the function of police, these refers to operations to enhance the safety of the public and provide necessary surveillance information to Police for both reactive and predictive policing. CCTV surveillance has been an important component across the multiple cities with increasing usage of video analytics to provide police with timely alerts for action.
- d. **Crisis Management:** These services addresses the major disaster-related events which may occur in a city affecting city as a whole (e.g. floods) or a part of the city (e.g. fire accident). The Crisis management operations in a city includes medical services, fire brigade and police which may need to react either together or in any combinations based upon the type of exigency. Being an important aspect of city ICCC, it is imperative that crisis management should be in place and properly implemented covering all the possible events which may disrupt either part of or complete city.
- e. **Convergence:** There are certain enterprise systems/application used by city government to support city operations. Services like geo-graphical information system (GIS) for the city tags all the important functions of a ULB on a map providing them a holistic view of the city. Service like Enterprise Resource Planning (ERP) is essentially integrated management of core processes across various services providing real-time, digitized information about the system. Such services cut across the length and breadth of the core services and thus must be

addressed in the city ICCC as they assist city administrators in visualizing information at pan-service & pan-city level with functionality to drill-down on specific part of the city or specific service if required.

These services can be assessed in detail on the basis of respective functional use case configured with ICCC platform. In first stage, cities will do the self-assessment of maturity of specific domain as per its readiness at ICCC. Smart City ICCC functional assessment would comprises of following component for each use case mentioned above:

- a) Data Acquisition and Visualization
- b) Data Analytics and Co-relation
- c) Communication
- d) Command and Control

Score would be assigned based on entering maturity of specific use case on 4 dimensions.

Functional Assessment Toolkit

Functional Maturity Assessment Criteria	<< Domain>> illustrative
<i>Data Acquisition and Visualization Capability Assessment</i>	100%
Have sensors devices, activators been deployed as a part of field infrastructure?	
Are the sensors deployed on the field geo-referenced?	
Do the sensors provide real-time data?	
Is the sensor data available at command center?	
Is the domain application data available at command center?	
Is the sensor data available in a geo-referenced manner at command center?	
Is the data from respective domain application/smart solution available in a geo-referenced manner at command center?	
<i>Maturity Level</i>	High / Medium / Low
<i>Data Analytics and Co-relation Capability Assessment</i>	100%
Does the sensor data generate exceptions based on pre-defined SLA thresholds?	

Are the thresholds automatically refreshed based on ground conditions?	
Is the data from sensor/ systems analyzed with data from other sensors/applications based on time of event?	
Is the data from sensor/ systems co-related from data from other sensors based on location of event?	
Does the co-relation from multiple sensors/ systems result in generation of alerts / exception?	
Does the co-relation offer diagnostic analysis of event?	
Does the co-relation offer prescriptive actions from event?	
<i>Maturity Level</i>	High / Medium / Low
Command & Control Capability Assessment	100%
Does the system offer standard operating procedures based on alerts?	
Does the system provide real-time view in terms of video, geo-location post generation of alert?	
Are the standard operating procedures (SOP) defined to include point of contact responsible?	
Are the standard operating procedures defined to include action for person responsible?	
Are the standard operating procedures defined to include pre-requisites?	
Are the standard operating procedures defined to include procedures?	
Are the standard operating procedures defined to include on-field/premise assets?	
<i>Command & Control Maturity Level</i>	High / Medium / Low
Communication	33%
Is the communication protocol (mode, contact details, alternates) included in the SOP?	
Does the system provide for audio communication over multiple channels to first respondent?	
Does the system provide for audio communication over multiple channels to all responders?	
Does the system provide for video communication to first respondent?	
Does the system provide for video communication to all responders?	
Does the communication channel provide for recording and playback?	

<i>Communication Maturity Level</i>	High / Medium / Low
<i>ICCC Functional Maturity Level</i>	High / Medium / Low

Scoring Assessment: Functional Maturity Assessment

Functional Maturity	Low	Medium	High
Score	< 50%	51%-80%	>80%

City would be able to assess the gaps under functional maturity based on self-assessment for specific domain. City administration is advised to bring its majority of operations systems from various domain under ICCC and measure the maturity of ICCC functional components to assess if ICCC platform is capable of managing its multiple and complex events on day to day basis.

Over and above ICCC Functional Maturity, ICCC needs to be assessed over Technology and Governance components. In next section, technology and governance toolkit is explained in detail.

II. Technology Assessment

Technology assessment score would be assigned based on maturity assessment of individual components of ICCC Platform to gauge the ICCC capability to support the functional requirements of city administration

- a) Data Acquisition and Collection Layer includes components for data acquisition and collection from various devices/ systems/ applications in different formats
- b) Data Analytics and Correlation Layer includes components to aggregate and process the data for analysis on different dimensions in order to derive intelligence out of information collected through different sources.
- c) Application Configuration Layer includes components involved in defining and configuring the multiple and complex events and its automated response.

d) Command and Control Layer includes components to manage the response, assets, devices, on field users and resources to address civic issues.

Technological Assessment Toolkit

Illustrative assessment framework with sample questionnaire is as follows:

A Data Acquisition		Criteria	Response
A1	Integration with Sensors	<i>Ability to collect and aggregate data in real time generating from on field sensors/Edge Infrastructure like Bin Sensors, Water Sensors, Environment Sensors, Access Sensors, Actuators Sensors.</i>	
A2	ETL Capability	<i>Ability of ICCC platform to consume raw data feeds from different data sources and ability to prepare information for downstream uses. E.g. Ability to process data coming through online systems, mobile apps, social media, edge sensors, third party applications and tools, data files (EXCEL, GIS etc.) and different data bases for effective interpretation.</i>	
A3	Integration with Video Feeds	<i>Ability to consume video feeds generating from various application capturing videos like Surveillance, Parking, Traffic etc.</i>	
A4	Integration with Data Feeds and Publishing Data Feeds	<i>Ability to consume real time data feeds from various systems/applications using APIs. For example capturing and monitoring data feeds related to Traffic Violations or Congestion in real time etc.</i>	
B Configuration Layer/SOP		Criteria	Response
B1	Configuration of SoP, Alerts	<i>Ability to configure to Standard Operating Procedure using ICCC Platform using data feeds form different systems/applications converging at I CCC .For E.g.: Allocating Ticket to field engineer of road department when ICCC receives potholes complaint. Or Generating Alert to Hospitals and Police Station in an event of Fire break out.</i>	
B2	Configuration of GIS	<i>Ability of ICCC platform to configure and use GIS application and open street maps for doing GIS analysis of domain specific use cases. For Ex: ability to view Civic Utilities like Fire Hydrant across city on City Map. Or Ability to identify city slum pockets on city map.</i>	
B3	Configuration of SLAs	<i>Ability to view SLA compliance/ non-compliance of various projects and applications using ICCC application. For ex : Garbage Collection SLA, Water Quality , Network Operations SLA etc.</i>	
B4	Configuration of Data Security Features	<i>Ability to configure user access and authorization control to provide specific set of information/data/application control to designated or authorized set of users. For E.g.: Ability to restrict water department operation team to view water billing data (if not authorized).</i>	
B5	Configuration of Network Control	<i>Ability to manage and monitor the network performance through ICCC platform using NMC application or third party application.</i>	

B6	Configuration of User Access Control	<i>Ability to configure and manage the user access to different application /facilities through ICCC.</i>	
B7	Configuration of Notification Control	<i>Ability to configure and manage user notification as per configured protocol. For E.g.: In case of SLA breach or alert, notification should be generated to configured user through ICCC application.</i>	
C	Data Analytics and Co-relation Layer	Criteria	Response
C1	Sentiment Analytics	<i>Ability to provide sentiment analytics of configured key words/accounts through internet crawling through ICCC platform. Ability to categorize key issues/topics/words in real time on social media platform (Twitter, Facebook, Google+, Website Discussion Forums, News Papers) which are contributing to negative/positive perception among citizens.</i>	
C2	Predictive Analytics	<i>Ability to make predictions about future events using past data. Predictive analytics uses many techniques from data mining, statistics, modeling to analyze current data to make predictions about future. For E.g.: Predicting key areas of civic concerns in specific areas using past and current data from city compliant management application/social media etc. or Predicting Bill projections of property tax using collection trends in past year.</i>	
C3	Prescriptive Analytics	<i>Ability to find best course of action for a given variable situation/scenarios .For e.g. : Choosing shortest routes or number of vehicles to collect garbage in given time slot in a day based on various factors like traffic congestion, proximity to transfer stations etc. Or planning best traffic planning with objective to reduce congestion during festivals at different point of time in a day.</i>	
C4	Diagnostics Analytics	<i>Ability to do the root cause analysis using data slicing, data aggregation, data mining, data discovery and correlation techniques using ICCC platform. For ex: Identifying key contributor to mosquito borne diseases: Monsoon or poor cleaning of drainage or specific patterns of temperature in given season.</i>	
C5	Descriptive Analytics	<i>Ability to view insights using past data for given data set. For Ex: Property tax Collection through different channels in given month in past three years.</i>	
C6	Video Analytics	<i>Ability to automatically analyzing video to detect and determine temporal and spatial events. For ex: Identifying number plates of vehicles in parking zone to levy high parking rates for vehicles from outside the city.</i>	
D	Command and Control Layer	Criteria	Response
D1	Operations/Processes Control	<i>Ability to provide assistance to city operations in various civic domains namely water, drainage, solid waste ,fire etc.</i>	
D2	SoP Control	<i>Ability to manage the SoPs lifecycle configured in ICCC platform.</i>	
D3	Access Control	<i>Ability to provide access or restrict access to user group for any facility or applications in real time.</i>	
D4	Device Control	<i>Ability to provide access or restrict access to user group for any actuators/devices like water supply sensors or edge devices on network in real time.</i>	

D5	Sensors Control	<i>Ability to access control like reboot and control any sensors on network in real time through ICCC platform.</i>
D6	Field Force Control	<i>Ability to assist field force of city administration by providing required support like assisting them by providing requested information and support in real time to manage civic operations.</i>
D7	Asset Control	<i>Ability to control the access to field assets through ICCC platform.</i>

Response Option:

1. Yes: Implemented and component capability could be demonstrated with various functional use cases.
2. No: Not Implemented but product component is available to City Administration.
3. Not Applicable: If component was not part of product specs at the time procurement thus not implemented at ICCC.

Scoring Assessment: Technology Maturity Assessment

Functional Maturity	Low	Medium	High
Score	< 50%	51%-80%	>80%

Technology Maturity Assessment will enable cities to assess to identify which components are extensively utilized and which are yet to be utilized to enhance the effectiveness of Integrated Command Control Centre. Technology Maturity Assessment would push cities to explore the potential of various components of ICCC platform to manage its civic operations.

Note: Each component is explained in detailed under **Annexure V**.

III. Governance Assessment

A city ICCC will not be able to function to its full potential if it does not have proper governance framework covering people, processes and policy dimensions to support ICCC operations and its sustenance.

- Governance Framework:** Essentially refers to the presence of governance policies as guidelines for ICCC manpower in terms of non-disclosure agreements, privacy policies, knowledge repositories, employment policies etc.
- Action-oriented dashboards for city leadership:** While it is imperative that an ICCC must be able to display information at aggregated level for city-level

management, it is equally important that such dashboards must be regularly utilized by concerned officials for their day-to-day or in crisis situations

- c) **Field force management:** This includes but not limited to design & implementation of workforce management plan with well-defined organizational hierarchy, manpower forecasting as well as escalation matrix for the concerned authorities to use and respond to situation in real time.
- d) **Resourcing and staffing:** With operations of ICCC being a specialized job, recruitment policies must be well documented and approved by all the concerned stakeholders. Once the policies are formulated – it is all the more important the right resources are on-boarded from departments/hired and that they are available round the clock for ICCC operations.
- e) **Technical capacity building:** The success of a city ICCC depends on the fact that the deployed manpower is regularly trained & re-trained on various technological and functional aspects of the ICCC. Also a training plan must be in place for both staff as well as executives based upon the functions they need to perform.

Governance Maturity Assessment Toolkit

Illustrative assessment framework with sample questionnaire is as follows:

A	Governance Framework	Response
1	Approved Data Governance policy is in place?	
2	Approved Co-Creation and Data Sharing Policy is in place?	
3	Approved CCC Management Structure is in place?	
4	Approved CCC Resourcing Policy is in place?	
5	100% CCC Seat occupancy SLA monitoring is in place?	
6	Interns on boarding policy is in place?	
7	ICCC Training and Capacity annual budget is in place?	

B	Support to Field Force (Vendors, Contractors, Officers, Employees etc.)	Response
1	Field Force uses mobile app connected with CCC?	
2	Field Force uses ICCC GIS service for day to day operations?	
3	Field Force can communicate two way with City CCC?	
4	Field Force SLA monitoring is in place?	
5	Scientific Work/area allocation through ICCC analysis?	
C	Decision Making Framework	Response
1	City Leadership is able to make decision on weekly and daily basis using ICCC analytics?	
2	City Officers is able to make decision on weekly and daily basis using ICCC analytics?	
4	Area wise/Department wise KPIs are configured in ICCC?	
5	City Leadership is able to assess performance of its officers/employees through KPI compliance using ICCC?	
D	Knowledge Management	Response
1	Is Knowledge Management application/services is operational for managing knowledge example critical documents, case studies, local knowledge etc.?	
2	Stakeholders can update any piece of information or intelligence in Knowledge base using ICCC interface?	
3	FAQs for services, processes and utilities are made available to citizens?	

Scoring Assessment: Governance Maturity Assessment

Functional Maturity	Low	Medium	High
Score	< 50%	51%-80%	>80%

Governance Maturity Assessment would help cities to assess its readiness from people, processes, and governance policies to manage Integrated Command and Control Centre.

Overall Integrated Command and Control Maturity Assessment:

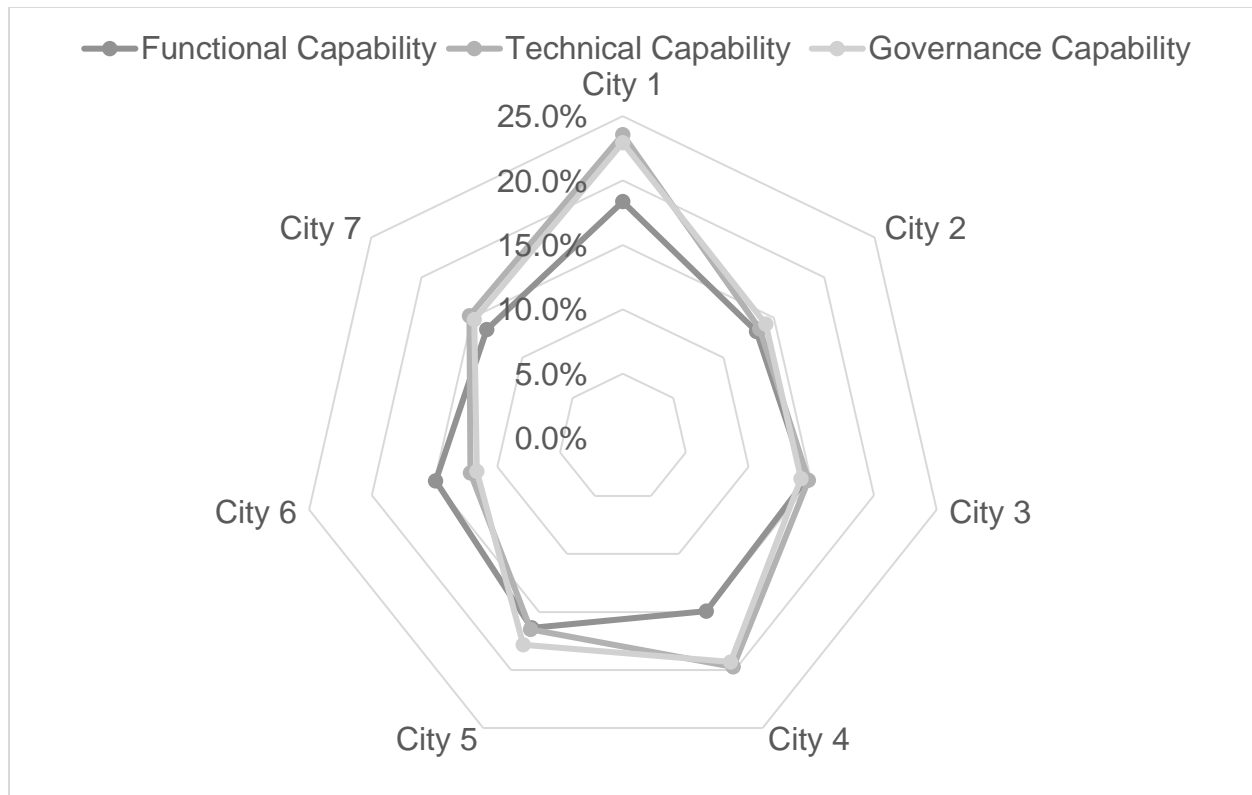
ICCC Maturity	Functional	Technology	Governance
Score	65% (Medium)	45% (Low)	60% (Medium)
Overall Score	57%		

Illustrative: ICCC Maturity Assessment

These three components (Functional, Technological & Governance) together form the crux of the assessment framework and will enable the assessment-taker to evaluate a city ICCC in terms of its current maturity as per the model defined in next section.

ICCC Maturity Assessment: Analysis and City Ranking

To assess a city ICCC on the above-defined parameters, it is required that the assessment-taker evaluates all the given use-cases for all the 3 parameters i.e. Functional maturity, Technological maturity & Governance maturity. For each use-case, an assessment-taker will review all the four attributes of the maturity model i.e. Visualization, Correlation, Communication and Commanding & controlling capabilities. ICCC Maturity Assessment Framework comprises of 3 broad assessment categories to gauge the maturity of ICCC. Cities can compare the capability score vis-a-vis other cities and identify the gap areas as shown below:



Illustrative: ICC Maturity Index Assessment

ICCC Maturity Ranking

Based on scores obtained by cities dynamic ranking could be published in order to instill sense of competitiveness among cities to improve the ICCC as an infrastructure.

a) City ranking over ICCC

- 1) Overall Functional Maturity
- 2) Overall Technical Maturity
- 3) Overall Governance Maturity

b) City Ranking over ICCC Functional Maturity Components

- 1) Civic Utilities
- 2) Mobility Services
- 3) Safety & Surveillance
- 4) Emergency Response
- 5) Convergence

c) City Ranking over ICCC Technical Components

- 1) Data Collection & Aggregation Capability
- 2) Sop's Configuration Capability
- 3) Data Analytics Capability
- 4) Command & Control Capability

- 5) Data Security Capability
- d) City Ranking over ICCC Governance Components
 - 1) Governance Capability
 - 2) Field Force Capability
 - 3) Decision Making Capability
 - 4) Knowledge Management Capability

Refer to Annexure VI to review the outcomes of assessment in different stages of the assessment.

6.2 Stage II: On Site Maturity Assessment

On Site maturity assessment is the second stage of our ICCC Maturity Assessment process. Third Party agency would validate the claims submitted by city wrt to self-assessment stage and gauge the maturity of integrated command control center. This stage involves more detailed assessment of ICCC capabilities including onsite assessment by third party auditors over the functional use case implemented by Smart cities through Integrated Command and Control Center.

Under on site assessment qualifying cities are required showcase the ICCC capability by demonstrating functional use cases which impacts service delivery or in turn livability index of city. Use Cases are defined (refer Annexure) to assess the outcome and document the impact on civic operations which are implemented at Integrated Command Control Center.

Maturity Assessment outcome would categorize the Integrated Command and Control Center into following category for specific use case:

Maturity Score	Classification	Description
< 40%	Absent	Functional capability of ICCC is absent for stakeholders (<i>City Administration/ Department officials/ on field employees/citizens</i>) and Impact (<i>Social, Economic, Environmental</i>) is low .

40%-55%	Enabled	Functional capability of ICCC is enabled for stakeholders (<i>City Administration/ Department officials/ on field employees/citizens</i>) and Impact (<i>Social, Economic, Environmental</i>) is low .
55%-70%	Established	Functional capability of ICCC is enabled for its stakeholders (<i>City Administration/ Department officials/ on field employees/citizens</i>) and Impact (<i>Social, Economic, Environmental</i>) is medium.
70%-90%	Leader	Functional capability of ICCC is established for its stakeholders (<i>City Administration/ Department officials/ on field employees/citizens</i>) and Impact (<i>Social, Economic, Environmental</i>) is High .
>90%	Lighthouse	Functional capability of ICCC is established for its stakeholders (<i>City Administration/ Department officials/ on field employees/citizens</i>) and Impact (<i>Social, Economic, Environmental</i>) is High along with innovative use cases.

Maturity Assessment would also help cities to identify gaps under design, planning and implementation for respective of ICCC project under smart cities. Lighthouse cities would emerge as mentors for other cities for guidance and handholding of other cities over managing ICCC.

Securing Integrated Command and Control Center Ecosystem

ICCC Self-Assessment questionnaire is designed to assess the cyber security dimension for Integrated Command and Control Centre.

7. Securing the ICCC Ecosystem

Why is security of ICCC important?

ICCCs shall be the “nerve center” of a smart city and are envisaged to aggregate information through smart-enabled integrated technologies. The ICCC is expected to provide a holistic view of all city operations allowing monitoring, control, and automation of various functionalities at an individual system level along with enabling cross-system analytics.

The smart-enabled integrated technologies and devices also bring in their inherent security risks. These technologies and devices connect to ICCC, which poses a threat to ICCC security. Hence, significant increase in the number of interconnected technologies and devices also result in phenomenal increase in the security attack surface.

The increase in the security attack surface provides an opportunity to cybercriminals, cyber activists, and nation states to exploit the attack surface to compromise the security of ICCC and, subsequently, of Smart City. Hackers and malicious actors now do not need to get direct access to ICCC or data center to compromise systems / applications, but can plan attacks through the technologies and devices spread across the Smart City. Therefore, as the Smart City makes use of the advanced and integrated technology to deliver services to the citizens in an efficient manner, the integrated technology expands the cyber threat landscape. Hence, it becomes imperative to consider the cybersecurity requirements for a Smart City, and particularly of ICCC, in a comprehensive manner.

What can happen?

Overlooking the security of ICCCs can turn out to be very expensive for an efficient and secure service delivery, and protection of human life. Some of the serious concerns regarding security of the Smart City services include:

- Through the compromise of integrated traffic management system hosted in ICCC, kidnappers / malicious actors can monitor live location of the buses, and other parameters and plan their attack accordingly
- Hacker can add/ remove/ modify/ delete sensitive information from the ICCC database, including residents' personal information, health information and sell the data (personal and health data) same in black market
- State actors from foreign nations can shut down the services (e.g., traffic signals across the city) offered to the citizens and create panic / havoc in the city
- State actors can also use access to post content to spread propaganda & disinformation campaigns
- Organized crimes can be committed by viewing CCTV live feed and then turn off the camera at the time of heist
- GPS systems can be hacked to redirect vehicles – such as ambulances, police vans, and school buses leading to chaos in the city.
- Aggregation and unauthorized statistical analysis of data collected by ICCCs can be done by miscreants leading to privacy risks and in worst case scenario, loss of human life.

What should be done?

Security and privacy should be considered across all phases of an ICCC development – design, implementation, operations – along with preparation for long-term assurance.

a. Cybersecurity framework and security by design

- i. A Cybersecurity framework should be developed aimed at building a secure and resilient ICCC for citizens and stakeholders of Smart City. The framework comprising of policy, procedures, and guidelines should be designed to protect ICCC and information; build capabilities to prevent and respond to cyber-attacks; and minimize damages through cyber-attacks. The framework should align to the following:
 - MoHUA guidelines vide circular K- 15016/61/2016-SC-1 dated 20th May 2016
 - Government of India guidelines on Data Security
 - IT Act and Amendment 2008
 - CERT-IN guidelines

- CMP guidelines on countering cyber-attacks
 - International standards including ISO 27001, NIST Cyber Security Framework
- ii. A secure network architecture should be designed following a layered security approach. Security solutions as detailed out in MoHUA guidelines should be considered, as appropriate, to protect the ICCC.
 - iii. Cyber security awareness trainings should be provided to different focus groups responsible for the security of ICCC.

b. Security while implementation

A governance mechanism should be setup to ensure that ICCC implementation conforms to secure requirements. Security assessment should be performed for all the ICCC associated applications, systems and devices before Go-Live.

c. Security during operations

Secure procedures should be followed during the ICCC operations. All the changes, operations, and monitoring of ICCC applications and systems should be performed in a controlled manner following a well-defined process.

A security operations center should be setup comprising of a threat analytics solution to give a reasonable security assurance for ICCC from emerging cyber threats. An incident response mechanism should be setup to respond in a coordinated manner to any security attack.

d. Security Assurance

A regular process should be setup to assess the ICCC compliance to security and Regulatory requirements on a regular basis. The gaps identified during the assessment should be actioned for mitigation depending upon the criticality.

ICCC Security Assessment Toolkit

ICCC Self-Assessment questionnaire is designed to assess the cyber security dimension for Integrated Command and Control Centre. These dimension are captured across different phases:

- 1. Design**
- 2. Implement**
- 3. Operate**
- 4. Assure**

Design

- 1. Have Cybersecurity policy, data privacy policy, security procedures and minimum baseline security guidelines been prepared to protect ICCC from different cyber-attacks?**

To ensure the data, applications, and systems associated with ICCC are secure, a cybersecurity and privacy policy needs to be developed. This policy document needs to be supported by detailed security procedures and minimum baseline security guidelines for edge devices (e.g., IoT, sensors, CCTV, servers, applications, network devices), and comply to cybersecurity guidelines and Regulations (e.g., MoHUA guidelines, IT Act and Amendment, Data Protection Regulation (upcoming))

- 2. Has a security organization been setup with clearly defined security roles, and responsibilities to protect the ICCC from cyber-attacks?**

A cybersecurity organization structure with clearly defined security roles and responsibilities is required be put in place both at Smart City management level, and MSI level with skilled personnel and resources.

3. Has a risk assessment been performed to identify and protect against applicable Cybersecurity risks?

A risk assessment needs to be performed to identify security risks applicable to ICCC. A detailed mitigation plan to be developed to protect against the security risks.

4. Has the compliance to the following regulations – MoHUA Guidelines under circular K- 15016/6U2016-SC-r, IT Act and Amendment 2008 and Personal Data Protection Bill 2018 (upcoming) – been considered during design, implementation and operations of ICCC?

Cyber security measures implemented in the ICCC need to be compliant with the mandatory cyber security framework published by Ministry of Housing and Urban Affairs (MoHUA) and the IT Act Amendment 2008. Data, applications, and systems associated with ICCC need to be handled and protected against different cyber-attacks.

Implement

5. Has a governing body been setup to oversee implementation of cyber security aspects for ICCC?

A governing body comprising of cyber experts need to be set up to ensure cyber security is considered during design and implementation of ICCC.

6. Are security assessment and secure code review performed for Smart City applications before Go-live?

All smart city applications need to undergo security assessment and source code review before the applications Go-Live for operations.

Operate

7. Have security specific procedures been designed and implemented?

Security related procedures including, but not limited to, Asset management, Change management, User access management, Privilege access management, Patch management, Backup management, Incident management, Physical and environmental security, Business continuity and disaster recovery etc. need to be prepared for ensuring secure functioning of ICCC.

8. Has a Security Operations Centre (SOC) been setup to detect and protect the ICCC from cyber-attacks?

A SOC needs to be setup to ensure continuous monitoring and manage cyber security operations pertaining to ICCC (and Smart City in general). A SOC is a secure facility dedicated to maintain situational awareness to detect and respond to cyber threats. Different ICCC components (systems, applications, devices) need to be integrated with the SOC to ensure protection and detection against cyber security incidents.

Assure

9. Are periodic assessments done to assess security for ICCC?

A periodic assessment need to be performed for ICCC on a regular basis to ensure that security is continuously maintained during the operations.

10. Are regular training programs being conducted for creating awareness about cyber security amongst stakeholders managing ICCC?

Stakeholders managing ICCC implementation and operations need to be aware of cyber security risks and associated security measures. Periodic security awareness training need to be imparted to different stakeholders to ensure that the security is being considered through design, implementation and operations of ICCC.

The best practices for the protection of ICCC from Cyber-attacks are tabulated below:

Phase	Sample Use Cases
Design	<p>Use Case 1: Cybersecurity policy, and procedures covering ICCC security documented</p> <p>Use Case 2: Minimum baseline security guidelines for applicable edge devices (e.g., sensors, IoT, CCTV), applications and systems documented</p>
Implement	<p>Use Case 1: Security requirements clearly identified during implementation of ICCC</p> <p>Use Case 2: Security assessment is performed for ICCC applications and systems before Go-Live</p>
Operate	<p>Use Case 1: ICCC operations are performed in line with security procedures (e.g., change management, incident management, backup management)</p> <p>Use Case 2: Security operations center generate security alerts for potential cybersecurity incidents. Dedicated team is responsible to monitor, detect and respond to security alerts.</p>
Assurance	<p>Use Case 1: Regular security assessment to assess the security maturity for ICCC</p>

8. Way Forward

ICCC's should be looked beyond the hardware components, ICCC software and its abilities plays a pivotal role to analyze, manage SOP's and correlate the data. Assessing the maturity of the ICCC must be done with a motive to understand the growth capability and to showcase the efficiency of the organization's implementation processes.

An independent assessment, is the need of the hour as only the first round of ICCCs have come up. There are many more in the pipe-line. With the guidance received from the assessment, the established units can work towards improving their in-house service operations by improving their maturity across functional, technological and governance aspect. Hence, the ICCCs can be meaningfully used to improve the city's livability through efficient urban services rendering, incidents and disaster planning and management from one location.

This assessment framework shall act as a base to assist the budding ventures in their operations and system integrations. With best examples identified from around the country, the learnings from the case studies and success stories can be replicated in other smart cities as well.

Annexures

Annexure I: Case Studies

Case Study I: Rio Operations Center, Rio De Janeiro, Brazil

The Rio Operations Center's responsibility is to control the city's daily operations, integrating several departments involved in Rio's routine; and to manage crisis and emergency situations.



Rio de Janeiro has been hit hard by repeated Atlantic storms imperiling the city. This especially affects the mostly low income settlements that are located on the high slopes surrounding the metropolis and are prone to devastating landslides. Following a vicious storm in 2010, Rio de Janeiro decided to create a center that operates 24 hours a day, staffed by officials from 30 city departments. This center has become a global model showing the benefits that can be derived from collaboration, alignment and data sharing across city divisions.

The model has had many other benefits for the day-to-day management of the city. Traffic emergency time response has been reduced significantly with citizens alerted about traffic snarl ups and accidents and redirected to the best routes. Data gathered for the center also enables the identification of neighborhoods with higher dengue fever infection rates. In planning the facility, Rio officials visited alert centers in Madrid, Seoul and New York, and have since forged cooperation with the city of Johannesburg that established a similar entity, the Joint Operations Committee.

City Information

City	Rio De Janeiro
Size and population development	1990: 9,595,000 2011: 11,960,000 2010-2015: +0.85% / year 2025: 13,621,000
Population composition	Ethnic diversity with many different communities ; 25% of the population is aged under 18
Main functions	Second industrial, service and financial center in the country after Sao Paulo. tourism hub
Main industries/business	trade, tourism, services, industries (chemicals, pharmaceuticals, petroleum products, metal products, textiles)
Political structure	Prefect who has municipal executive power and is directly elected by a two-round majority system and the Rio de Janeiro Municipal Chamber which has legislative power
Administrative structure	1 Municipality (Prefeitura), 19 Sub-prefectures (subprefeituras), 34 Administrative Regions
Website	http://www.rio.rj.gov.br/

Background and Objectives

In April 2010, the city endured heavy rains (over 304mm in 24h) and 68 people died due to landslides. Moreover, 22.72% of the city's population (around 1.47 million) lives in vulnerable low-income communities, most of which located in slopes. A 2010 study conducted by GEO-Rio (Rio Institute of Geotechnical Foundation) identified 20,000

households on high geological risk areas – 2,000 of them have already been relocated through public housing programs.

The Rio Operations Center was officially created by a Municipal Decree on December 23, 2010, with the goal of increasing the city's resilience. The Decree determines its responsibility to control the city's daily operations, integrating several departments involved in Rio's routine; and to manage crisis and emergency situations. The Decree also establishes that the Rio Operations Center should interact with the media in disseminating and receiving information related to crises and process information from the 1746 Hot Line.

Inaugurated in December 2010, the Rio Operations Center was created primarily for risk management and prevention though it soon became clear that it was also a strategic tool for administrating urban mobility and coordinating large scale events.

The promotion of greater integration – internal and external – of the municipal administration has been established as one of the city's guidelines in the city's strategic plan. The Rio Operations Center was designed to improve the cooperation and the communication between government entities, and to deliver relevant information for public departments and the population. It increased the capillarity of municipal departments and their reach. Its goal is to monitor and optimize the city's operations, as well as anticipate solutions and minimize occurrences.

Implementation

The Rio Operations Center is a Rio de Janeiro City Hall initiative. Its technological platform development was done by the Municipal Company of Information Technology (Iplan) and the Pereira Passos Municipal Institute of Urbanism (IPP). The Rio Operations Center was designed based on the technological expertise of partners such as: IBM, Bilfinger, Cisco, Samsung and Google. Using Google Earth technology, it was possible for Iplan to create an integrated system of georeferenced data from all municipal assets involved in Rio's daily operational routine – the Geoportal software. The Operations Center collaborated with Oi and TIM (telecom companies), which implemented the links for data transmission.

The Control Room – the heart of the project – where 200 controllers, in three 24/7 shifts, monitor the city in real time, receiving images from over 900 cameras, through 30 km of fiber optic cable. The 60m² videowall in the control room, is composed of 80 46-inch monitors, which rely on Bilfinger and Samsung technologies. Cisco provided the tele-presence system, and Itautec provided the computer network used by employees of the Operations Center.

The Crisis Room is used for emergency meetings with different departments, connected to two other small crisis rooms, one at the mayor's official residence, and the other at the Civil Defense Service.

The Press Room is where media representatives are constantly releasing alerts to the population. The communication with all media outlets is a two-way exchange of information that amplifies the communication of the municipal authorities' messages, thus increasing its capillarity, and recommendations to the population. The media also warns the Rio Operations Center whenever there is an atypical event notified by their audiences. The creation of a channel of communication improves the public policy quality, and guarantees transparency, accountability and public trust.

The 1746 Hot Line is a communication channel with City Hall, whereby citizens can report problems, requests and complaints about city services, get information about debts, fines and permits, and even tourist information. Along with the communication strategy, transparency and the digital engagement of citizens is fostered.

The Rio Operations Center has three areas of operation: risk prevention and management, city's operations and major public events.

1. **Risk prevention and management** aims to save lives and includes the weather forecast, rainfall volume monitoring, and general security measures. This integration of data and teams made the Operations Center the focal point for crisis situations management in a city historically suffering from heavy rains and flooding.
2. In **routine operations**, through tools of intelligent monitoring and direct contact with the field teams, the Operations Center becomes aware on any occurrence of

which impact on the city's routine, responds with the necessary steps and guides the public about how to proceed to circumvent possible problems.

3. The daily learning process of how to conduct the city's dynamics with the Rio Operations Center as a new operational management focal point has contributed **to improve planning for major events** such as the 2013 World Youth Day and the 2014 World Cup.

To process all data generated in the Rio Operations Center, City Hall created the Big Data department "PENSA – Ideas Room" in June 2013. This new department aims to search, analyze and evaluate correlations and define impacts by crossing different databases, in order to improve service delivery to citizens. "PENSA" possesses access to all municipal databases. Big data management enables research to look for patterns and analysis that could not be achieved otherwise. It is possible, consequently, to plan policies based on accurate information. Now, data generated, for instance, by the daily management of traffic operations are now also used for public transportation policy and traffic planning.

Financing and resources

City Hall constructed a three-story building at a total cost, including equipment, of R\$ 20 million (approximately US\$ 8.9 million). The Rio Operations Center gathers almost 30 city departments, public agencies and utility companies, as well as State Government's representatives.

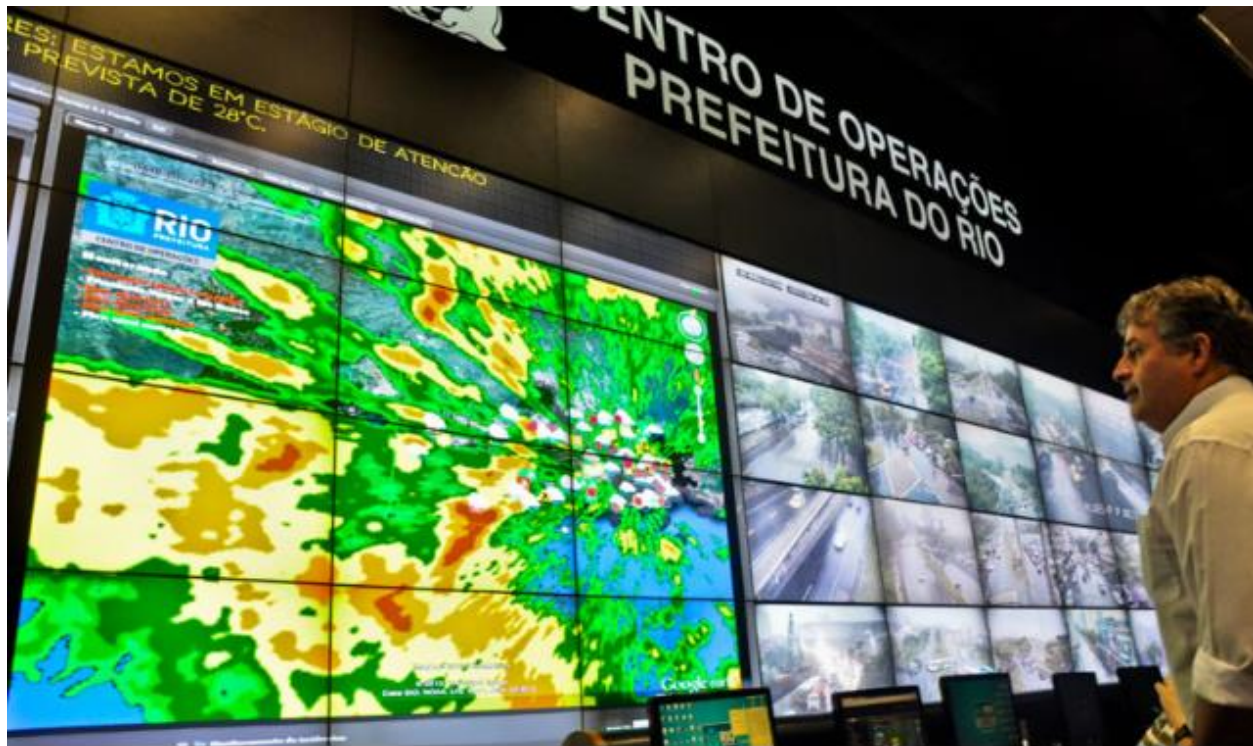
Results and impact

The Rio Operations Center enables a new administration model that provides communication and coordination between public entities, facilitates information sharing and enables prompt and efficient decision-making processes.

The center improved the city's management efficiency in many different areas – public transportation is one of them. Transportation is a major challenge in megacities like Rio de Janeiro and increased efficiency and use of public transportation are key to a sustainable urban development. Representatives of Bus, BRTs, Train, Ferry and Subway companies are present at the Rio Operations Center. The emergency response time was

reduced by 30%. When any traffic incident is identified, traffic teams are rapidly sent to the location to solve it. The city's map, with over 80 digital layers, shows data such as the present location of all municipal vehicles and equipment.

In the case of street maintenance, the center coordinates the municipal or concessionaries' teams responsible for the repair and



d traffic control. Another example was the work developed on dengue fever, a mosquito-transmitted disease with a high incidence level on summer. The geographical analysis of cases enabled the identification of the neighborhoods with the highest infection rates. City Hall used the information to implement preventive actions.

Barriers and challenges

Each department has its own organizational background. Through the years, each developed its standard procedures. The decision making process used to be fractionated. In most cases, communication was done bilaterally. Departmental rivalries and information withholding had to be overcome. By integrating all stakeholders in the same room, all departments receive information simultaneously and in contact with other agencies. This collaboration constitutes a daily learning process. The Rio Operations

Center is not vertically structured, thus these interactions are constantly improved. Protocols for coordinating actions in over 150 types of occurrences were established.

To respond the challenge in terms of qualified human resources, the 400 employees go through continuous training and simulation exercises.

Lessons learnt and Transferability

In an increasingly urbanized world, with local governments facing several challenges such as traffic, hampering more and more citizen's lives and the consequences of climate change, with the proliferation of severe weather related events, an operations center is a strategic tool for smart megacities.

During the Rio Operations Center's conception, city officials visited similar centers in Madrid, Seoul and New York. The Rio Operations Center has been visited by dozens of delegations, including government officials, private companies and university students.

The effort to increase the city's resilience involved a comprehensive set of measures. The Rio Operations Center has a team composed of four meteorologists and seven technicians that work 24/7 monitoring the weather conditions with a variety of online information mechanisms. The whole weather technological system is linked to the National Space Research Institute (INPE) computers.

The communication strategy is key to alert the population about incidents and redirect them to the best alternative. Waze is one of the tools used, as well as three daily bulletins reporting the main occurrences are released on the Rio Operations Center's website, by SMS, Twitter and Facebook accounts as well as radio and TV stations which are present 24/7 in the Rio Operations Center.

As an effort to educate the dwellers on how to prepare to risk situations, the Civil Defense created the Community Protection Program focusing on three subjects:

1. Training of Community Agents,
2. Community Alarm and Alert System, and
3. Simulation Exercises at Public Schools.

Similar centers in the world, such as CISEM in Madrid, coordinate police, fire and ambulance services. The Rio Operations Center is unique due to the quantity of public

services and concessionaries integrated. The enormous quantity of data collected by the Rio Operations Center and the 1746 Hot Line is also being used in other initiatives.

Rio Operations Center

Case Study II: Integrated Centre for Security and Emergency in Madrid
(El Centro Integrado de. Seguridad y Emergencias. (CISEM), Madrid, Spain)



City Information

City	Madrid
Size and population development	2001: 2,938,723 2011: 3,198,645 2015: 3,141,991 -.56%/year [2011 → 2015]
Population composition	In 2015, about 89.8% of the inhabitants were Spaniards, while people of other origins, including immigrants from

	<p>Latin America, Europe, Asia, North Africa and West Africa, represented 11.2% of the population. The ten largest immigrant groups include: Ecuadorian: 104,184, Romanian: 52,875, Bolivian: 44,044, Colombian: 35,971, Peruvian: 35,083, Chinese: 34,666, Moroccan: 32,498, Dominican: 19,602, Brazilian: 14,583, and Paraguayan: 14,308. There are also important communities of Japanese, Filipinos, Equatorial Guineans, Uruguayans, Bulgarians, Greeks, Indians, Italians, Argentines, Senegalese and Poles</p>
Main functions	<p>The capital city of Spain, seat of government, and residence of the Spanish monarch, Madrid is also the political, economic and cultural center of Spain. Madrid is considered the major financial center of Southern Europe and the Iberian Peninsula</p>
Main industries/business	<p>Madrid is the 5th most important leading Center of Commerce in Europe (after London, Paris, Frankfurt and Amsterdam) and ranks 11th in the world. The headquarters of a number of leading companies are located in Madrid. The leading industries are: paper, printing & publishing, energy & mining, vehicles & transport equipment, electrical and electronic, foodstuffs, clothing, footwear & textiles, chemical, industrial machinery.</p>
Political structure	<p>The City Council consists of 57 members, one of them being the mayor. The mayor presides over the RKO.</p>
Administrative structure	<p>Madrid is administratively divided into 21 districts, which are further subdivided into 128 wards (barrios)</p>
Website	<p>emergenciasmadrid.com</p>

Background and Objectives

On March 11, 2004, Madrid suffered a major terrorist attack when several commuter trains were bombed. As with the 9/11 attacks in the United States, this tragic incident highlighted the need for greater coordination among first responders. “The different emergency entities----the police, the fire department, the ambulance service and the mobile police----intervened independently, and all of them had disparate communication systems and technologies,” says Fernando Garcia Ruiz, head of innovation and development, Department of Security for the City of Madrid. There was no way to organize a unified response to incidents, and there was a lack of centralized command and control.

A key lesson was that more than one major incident can happen simultaneously, and emergency assets may be needed in more than one place. Different incidents may be related, or have nothing to do with one another----without a clear overall picture, it may be impossible to tell if there is an important pattern emerging. This potential for complexity poses a significant challenge for emergency managers. They not only need to coordinate activity, but also require a thorough understanding of everything happening in the metropolitan area so as to properly allocate limited resources to provide the best response to each incident. In addition, proactive measures such as limiting access to impacted areas, or crowd and traffic control for public events, has to be included in the mix. The need, therefore, was not only for top-down coordination, but also for the ability to capture and integrate information to give managers the understanding and insight required to quickly make the right decisions.

Implementation

This complex project began in 2005 and concluded at the end of 2007 with the physical and technological integration of the Command and Control Centers supporting the Security and Emergency Services in the capital of Spain. Over the course of the following years the project was consolidated, including further updates of the innovative technology platform. After the guarantee period, maintenance tasks for all the systems have been undertaken from 2009 to the present day.

IBM provided the software needed to create a service-oriented architecture (SOA) which allowed for the seamless coordination and integration of all first responder agencies and

emergency services involved. Indre, a global technology company, designed and developed the command and control center, which combines information from many sources including video feeds, field reports and mobile computers. They also designed the operation room, crisis room, auxiliary offices, data center and mobile control centers.

Because each of the first responder agencies had its own communication technology, a common mobile infrastructure had to be deployed. Most vehicles, from police cars to ambulances to fire engines, are equipped with mobile wireless computers or PDAs that are connected to CISEM. The mobile infrastructure is critical; it provides true interoperability among the various agencies and also enables a two-way interchange of information----which gives managers vital, on-the-scene input that helps them develop a better understanding of what is happening in the field.

A multilayered, redundant communications infrastructure links to existing telephony systems, VoIP, satellite communications, a private radio network and 3G wireless networks to ensure continuous communication. IBM WebSphere® Everyplace® Connection Manager provides seamless, reliable, secure access to CISEM resources by automatically selecting the best available network and encrypting all communications. IBM Tivoli® Directory Integrator adds an additional layer of access security.

Financing and resources: Approx. 20 million Euros.

Results and impact

The combination of forward-looking system design and end-to-end integration gives emergency managers in Madrid the tools needed to not only deal with today's threats, but also handle rapidly evolving situations and technologies as they emerge. Any sensor input----video, data or voice----from any source can be readily incorporated into the data stream and accessed by anyone who needs it.

Not only do commanders at CISEM understand the full situation, but those in the field are also made aware of the status of other teams and resources. This single, unified view of status and events reduces confusion and enables far faster and more effective decision making. Managers are now better able to deploy the right assets the first time, reducing response time by 25 percent. Commanders are now able to understand how complex and/or multiple incidents affect the entire region, and can allocate and deploy emergency

resources in a truly coordinated and effective manner that takes into account all of Madrid's needs, not just those of a single incident.

Barriers and Challenges

The key to CISEM is integration----of information, systems, data sources and people but it was a challenge. Not only this the city have to integrate all the applications currently used by the different entities, but also integrate other external organizations, like Madrid 112, the video surveillance center, and the M30 highway control center.

Case Study III: Surat Smart City Center, Surat, India



City Information

City	Surat
Size and population development	1991: 1,498,817 2001: 2,433,835

	2011: 4,467,797 Change: +6.26%/year [2001 → 2011]
Population composition	An ethnic mix of people speaking Gujarati, Sindhi, Hindi, Marwari, Marathi, Telugu, and Odia; also has a sizeable Parsi and Jewish population
Main functions	The second-largest commercial hub of western India after Mumbai
Main industries/business	Surat is known for diamonds, textiles, and for diamond-studded gold jewels manufacturing; Three-quarters of the world's diamonds are cut and polished in Surat
Political structure	The Surat Municipal Corporation is responsible for the maintaining city's civic infrastructure as well as carrying out associated administrative duties. The powers have been vested in three Distinct Statutory Authorities: the General Board, the Standing Committee, and the Municipal Commissioner.
Administrative structure	1 Municipality, 29 wards
Website	www.suratmunicipal.gov.in

Background and Objectives

Surat is one of the first 20 cities selected under the Smart City Program initiated by the Indian Government. Surat, a port city, is the eighth largest city and ninth largest urban agglomeration in India. It is the second largest city in the state of Gujarat, after Ahmedabad. Surat is the 34th-largest city by area and 4th-fastest developing cities in a study conducted by the City Mayors Foundation, an international think tank on urban affairs.

Considering the fast growth of the city and increasing demands and expectations of citizens from the city-government, Surat Municipal Corporation (SMC) has envisaged a Smart City Plan to serve citizens in an effective manner.

For the corporation to monitor different services, like night brushing, cleaning of roads, garbage collection and disposal, road repairing, health services and illegal construction, SMC has implemented a Smart City Center. In times of exigencies, the center is to double up as an emergency operations center that will coordinate and execute tasks with different agencies in the city.

Implementation

The SMART City Center (SMAC Center) is an initiative of the Surat Municipal Corporation under the Smart Cities Mission of the Government of India. The Surat Smart City Development Ltd (SSCDL), a Special Purpose Vehicle (SPV), is responsible for the execution of all Smart City Projects in Surat.

Inaugurated in June 2016, SMAC center uses ICCC platform integrated with a GIS platform with 12-13 layers for the project. This center is linked with the CCTV project of Surat city police department that has over 650 CCTV cameras at different locations. An additional 1,000 CCTVs, proposed to be set up by the SMC soon, will also be linked to this center.

This center collects functional information of all the departments and public on a real-time basis. Automated sensors and systems send various data sets to the SMAC, which are analyzed to avail important information to make decisions. All the online applications and mobile applications of SMC for people-centric services would be monitored from one place at the Smart City Centre. Birth and death certificates, relevant information on development plans and essential services, including water supply, are being integrated at Smart City Centre. During the time of natural calamities like floods, officials of different departments can remain in contact through the center.

Results and impact

With the implementation of this pilot project, SSCDL is able to monitor traffic movement, control the smart street lighting system and maintain a bird's eye surveillance of the city from the SMAC. This center is collecting functional information of all the departments and public on a real-time basis and helping all the departments in maintaining civic service delivery standards on a day-to-day basis.

Annexure II: ICCC Functional Use Case: Street Light Management



Domain: Street Light

Category: Civic Utilities

Expected Outcomes:

- a) Cost and Energy Savings
- b) Operational Efficiency
- c) Safe Streets and Localities
- d) Reduction in Crime
- e) Citizen Engagement

UC-1 How can we manage city street lights to optimize energy consumption and ensuring better safety of citizens in locality?						
S.no.	Parameter (Qualifier : facility on min 70 % of the deployed infrastructure)	Must have / Good to have	Category (Visualization / Analytics/ Communication / Command & Control)	Weightage	City Status (0- not available, 1 - available)	City Score
Data Acquisition Layer						
1	View street lights, controller and feeder on the city map	M	V	15%	1	
2	Receive Ambient light alert (fog/rain/smoke/Thunder)	M	V		0	
3	View KPIs on the dashboard	M	V		1	
4	View real time meta data from street poles	M	V		0	
5	View designated unsafe streets on city map (Marked by police/ city administration/ citizens)	M	V		1	

6	View heat-map based on street light complaints from different areas	M	V		1	
7	Real time monitoring of streetlights – energy consumption status	M	V		1	
Communication						
8	Trigger Event as per configuration (Detect, inform, track, analyze)	M	C	20%	1	
9	Communication capability over VMD, PAS, social Media, over movement of the vehicles in the designated zone as well as option for re-routing of the traffic	G	C		1	
10	Two way communication with field response team	G	C		0	
Command and Control						
11	Light on/off control at individual light level	G	C&C	35%	1	
12	Brightness control	G	C&C		0	
13	Light on/off control at group light level	M	C&C		1	
14	Auto dimming schedule based on geo location	G	C&C		0	
15	Light On/off as per pre-set ambient condition	M	C&C		1	
16	Light On/off motion based	G	C&C		1	
17	Light Intensity /Luminosity - auto increase/ dimming as per ambient conditions	G	C&C		0	
18	Power saving mode - When there is no changes in environment and during night time, dimming the lights (reduce luminosity) and switch off alternate lights.	M	C&C		1	

19	Traffic based light control	G	C&C		0	
20	Availability of manual overrides	M	C&C		0	
Data Analytics and Co-relation						
21	Analyze pattern of alert originating from emergency kiosks	M	A	35%	1	
22	Analyze trends over dashboard for Street Light Maintenance Dashboard.	M	A		0	
23	Lighting policies (time stamp, GPS data, and observed value) for different street conditions (Accident prone, isolated area, slippery roads/ people density.	M	A		1	
24	Prediction of optimum Light Intensity based on Ambient Light and Sensor Data	M	A		0	
25	Asset tracking and replacement SLA	M	A		1	
26	Street light complaint management thru citizen mobile app	M	A		0	
27	Auto Learn the existing occupancy pattern and predict occupancy patterns for future planning	M	A		1	
28	Report based on :	M			0	
(a)	Total burn hours calculation of streetlights	M	A		1	
(b)	Correlation between Environmental Sensor & Smart Light	M	A		0	
(c)	Predictive maintenance alerts	M	A	1		
(d)	Fault detection and alerts on map	M	A	0		

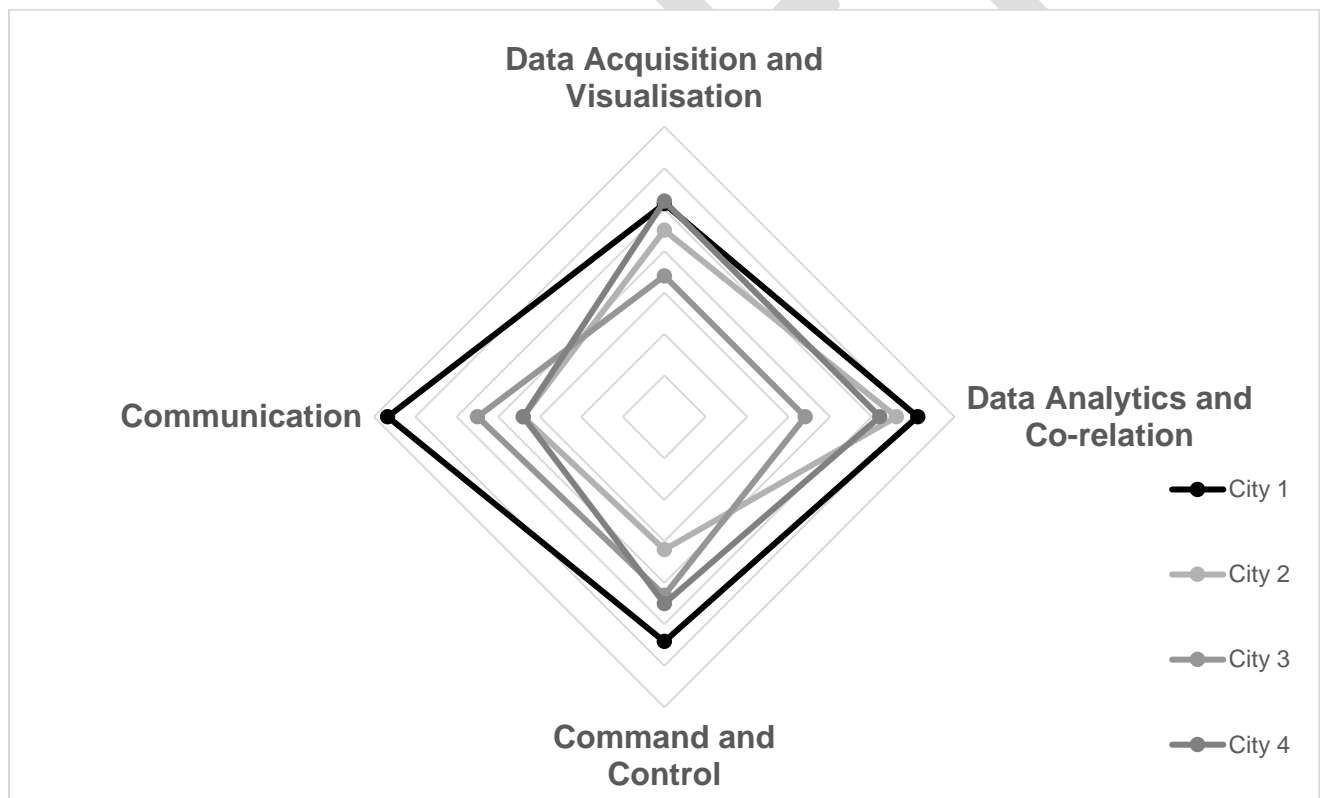
(e)	Automatic SMS/ Email alerts to the maintenance team	M	A		1	
(f)	Trend analysis on energy pattern consumption	M	A		0	
(g)	Auto ticket generation for faulty lights	M	A		1	
(h)	Report of Actual v/s prescribed Burn hour	M	A		1	
29	Ability to use camera/ sensor based streetlight to detect distress call/noise/ gun shots etc., Help in traffic rerouting, emergency trigger etc.	G	A		1	
30	Ability to create useful analytical data sets	M	A		0	
31	Visible impact thru streetlight- provide evidence- like Parking enforcement/Traffic Jam mgmt.	M	A		1	
32	Correlation between natural lux levels and that generated by street lights to plan proper power to the light.	M	A		0	
33	Light working and non-working trends last week, last month etc.	M	A		0	

Annexure III: ICCC Maturity Assessment Analysis

Functional Maturity Assessment Analysis

Functional Maturity assessment is designed to assess the functional maturity i.e. city utilities and operations are categorized as follows or also possible to do the analysis of specific domain:

- e) Civic Utilities and Services (water supply, Solid waste, drainage etc.)
- f) Mobility Services (traffic, transport and parking)
- g) Safety and Surveillance (Security)
- h) Crises and Emergency Management
- i) Convergence (Integration with Common Enterprise Systems)

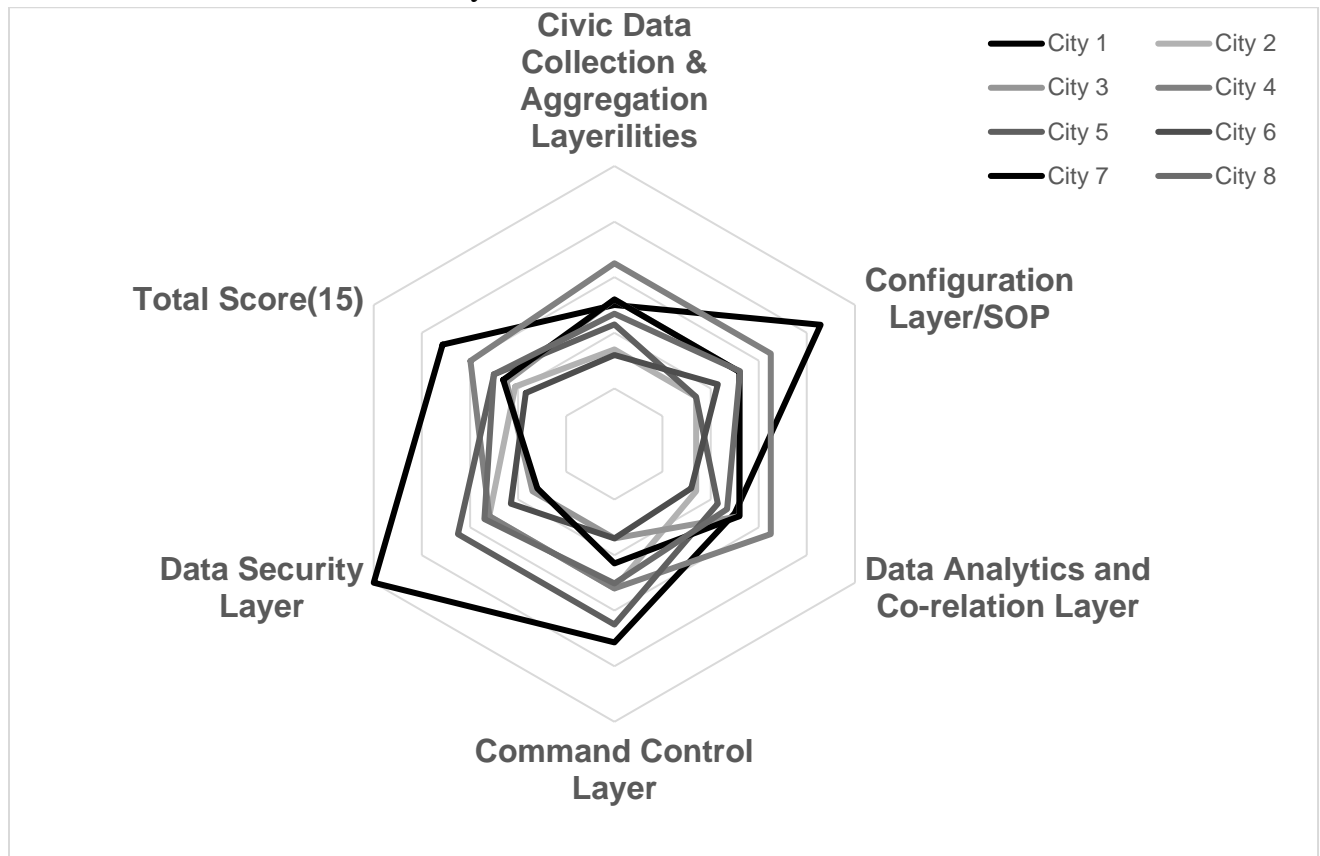


Illustrative City wise Assessment over Functional Capability of ICCC

Technical Maturity Assessment

Technical Maturity assessment is designed to assess the product maturity i.e. product features and components used by ICCC which are categorized as follows:

- a) Data Acquisition and Visualization Components
- b) Configuration Layer Components
- c) Data Analytics and Co-relation Layer
- d) Command and Control Layer

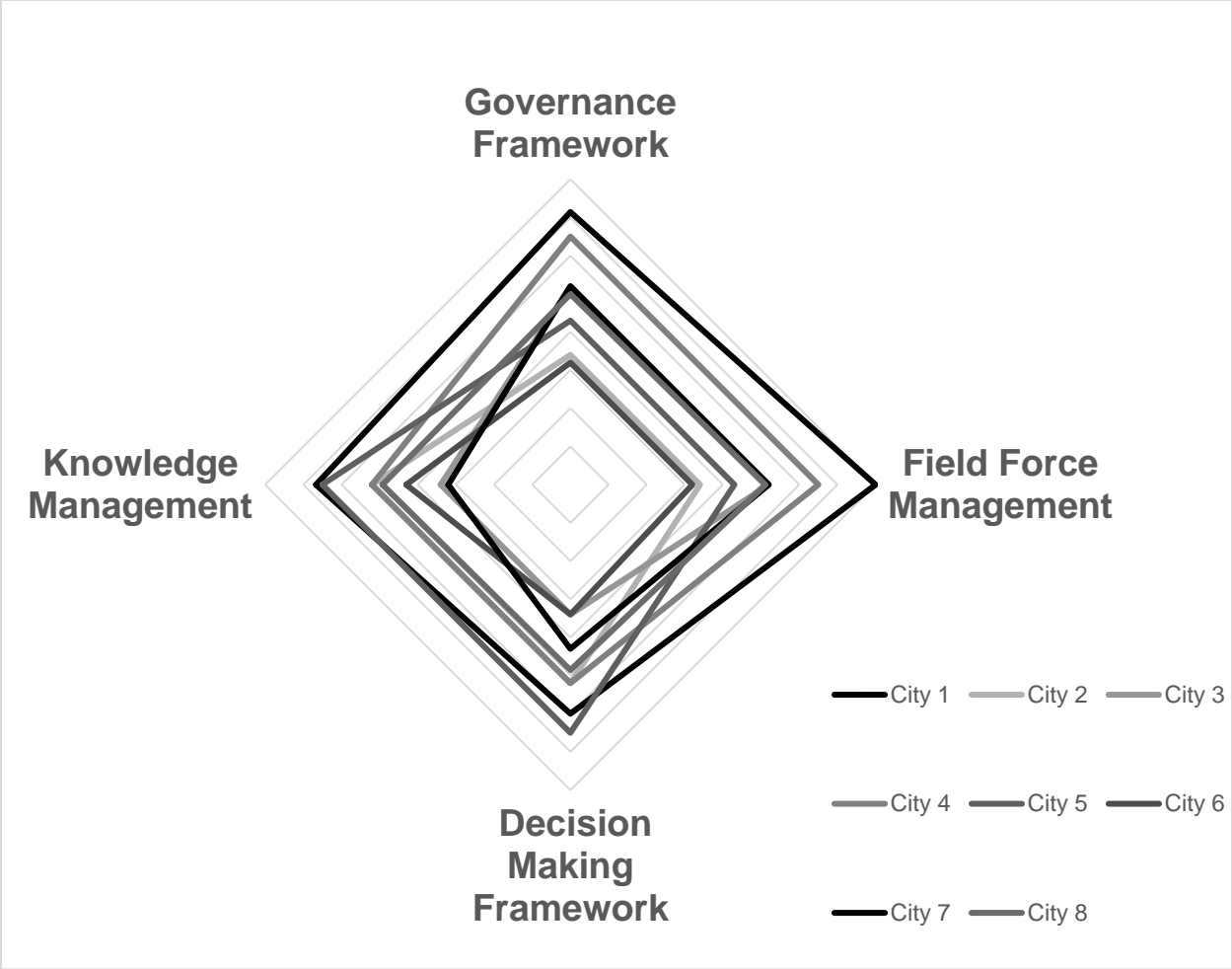


Illustrative City wise Assessment over Technical Capability of ICCC

Governance Maturity Assessment

Governance Maturity assessment is designed to assess the governance dimension i.e. organization governance features which are categorized as follows:

- a) Governance Framework
- b) Field Force Governance Framework
- c) Decision Making Framework
- d) Knowledge Management



Illustrative City wise Assessment over Governance Capability of ICCC

Annexure V: Use Case Repository

#	Category
A	Safety and Surveillance
	Make citizens feel safe in the City?
	How to ensure safety of citizens during emergency/disaster situations?
	How to predict crime in a City using Data Analytics?
B	Solid Waste Management
	How to improve cleanliness at public places?
	How to improve public toilet facility monitoring and servicing?
	How to manage on demand Waste Collection in City?
	How to manage Solid Waste Management Operations effectively?
C	Water Supply
	How to ensure reliable and quality water supply in city?
	Reduction of potable water wastage in the city?
D	Emergency and Disaster Management
	How to reduce the damage to property/life in case of fire event in a busy area of city?
	How to reduce the damage to property/life in case of Disaster/Emergency event in a busy area of city?
E	Service Delivery
	How to monitor and manage civic complaints effectively?
	How to gauge Citizen Satisfaction to citizens to improve service delivery?
F	Civic Health Use Cases
	How to reduce victim transit time from accident location to Hospital?
	How to effectively tackle mosquito borne diseases in city?
	How to strengthen Civic Health Care delivery in the City using Data Analytics?
	How to predict Stray Dog menace in the City?
G	Street Light
	How to monitor and maintain street lighting networks remotely
H	Transit and Mobility Use Cases
	How to effectively manage City Bus Operations?
	How to do City Traffic Planning using Data Analytics?
	How to identify open parking spots in City?
	How to monitor entry of vehicles to restricted Zones?
I	Roads Management
	How to reduce citizen inconvenience during road maintenance?
	How to effectively tackle potholes problems in City?
J	Waste Water Management

	How to control affluent disposal into city river water?
	How to ensure the storm water network readiness before rains?
K	Environment
	How to increase the green cover of the City?
	How to address air and noise pollution in city using environmental Sensors?

DRAFT

A. Safety and Surveillance

Safety

Linked Indicators: Livability Index Framework

- Number of CCTV cameras installed in the city per unit of road length
- Number of recorded crimes per lakh population
- Extent of crimes recorded against women, children and elderly per year
- Transport-related fatality per lakh population

Use Case 1: How to make city a safer place to live?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
Make citizens feel safe in the society?	Location of all CCTV cameras, police stations, Beat Marshals and Rapid action teams visible on the city map with feeds from CCTV	Location wise analysis of crimes in the city. Extent of crimes recorded against women, children and elderly per year	Trigger events for the utilities/ acting parties as per defined rules	CCTV Network across the city providing regular video feeds
	Marking few areas as 'Critical' for safety and security and putting up VMS for data display	Analysis and dashboard for classification of Crimes as per their types	Automated Messages to the Rapid Action Teams during the Law and order situations	Instantaneous event reporting to respective authorities e.g. Police, Fire brigade

	Keep an eye on the entire city by collaboration with schools and housing societies to gather video feeds from private CCTV camera networks	Sentiment analysis by analysing citizen feedback about various safety issues in the city by ensuring anonymity of contributor	Automated messaging to citizens for providing regular updates during an emergency situation	On field warning systems e.g. Sirens, Public address systems to discourage defaulter in case event is being viewed at the control centre
	Ability to view the dashboard/ intelligent word cloud from the data collected from internet, mobile app and social media	Integration of GPS for optimized route tracking with Emergency Response teams.	Awareness campaigns by authorities with citizens at large to remove the fear against the system	Creation of Green and Emergency corridors/ passages by traffic signal management for quick response
	Ability to map and view all accident and theft related data on the city map	Integration of face detection with CCTNS system. Transport-related fatality per lakh population	Anonymous complaint logging mechanism to ensure safety and privacy of complainant (removal of fear from the mind of citizens while raising voice against unlawful situations)	Drones for video surveillance

Use Case 2: How to ensure safety of citizens during emergency/disaster situations?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
Ensuring Safety of citizens in case of emergency/disaster situation (Fire, Riots, Epidemic, Morcha, Forest fire, Chemical Hazard etc.) in city?	Location of all CCTV cameras, police stations, Beat Marshals and Rapid action teams visible on the city map with feeds from CCTV	Location wise analysis of crimes/ fires/ riots/ epidemics in the city	Better use of Public Address System to communicate messages	EWS & Disaster management
	Marking few areas as 'Critical' for safety and security and putting up VMS for data display	Analysis and dashboard for classification of crimes/ fires/ riots/ epidemics as per their types	Incident & Complaint management	Traffic diversions & signal mgt.
	Keep an eye on the entire city by collaboration with schools and housing societies to gather video feeds from private CCTV camera networks	Sentiment analysis by analysing citizen feedback about various safety issues in the city by ensuring	Feedback/ awareness - Civic Services	GIS plot with Safe zones indicators

		anonymity of contributor		
	Ability to view the dashboard/ intelligent word cloud from the data collected from internet, mobile app and social media	Integration of GPS for optimized route tracking with Emergency Response teams	Two way Communication with Ambulatory services for effective service	Smart Street lighting management
	Ability to view the heat maps of fire prone areas on the city map based on past incidences and patterns	Integration of face detection with CCTNS system	Information to Women safety, Patrol Services for quick response	Crowd management and Security Breach handling

Use Case 3: How to predict crime in a City using Data Analytics?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to predict crime in a given areas?	View designated unsafe streets on city map (Marked by police/ city administration/ citizens)	Generate Heat-map of common crimes from different areas	Notifications to the citizens about Crime in sensitive areas	Ability to use camera/ sensor based streetlight to detect distress call/noise/ gun shots etc, Help in traffic rerouting, emergency trigger etc.
	View Real time video streaming of camera feed	Trigger Event as per configuration (Detect, inform, track, analyze)	Deployment of Protection and Surveillance team in sensitive areas	Two way communication with field response team to assist them in rescue or mitigation operation.
	View heat-map based on street light complaints from different areas	Apply Predictive Analytics over crime date over different dimensions.	Alerts sent to various dept.'s. (like Police, Fire, Hospitals)Standard operating procedure to be invokes	On Field Resource Mobilisation in real time
	Specific gestures include Distress , violation of traffic rules ,detection of crowd gathering	Map High potential areas of crime : Crime Type, Crime Severity, Crime Location	Educating citizens to contact nearest support ecosystem at the time of distress	Coordination with Community Volunteers in event of Crime
	Ability to view objects for tracking and	Analyzing Data generating on social		

	monitoring :Missing Car, Missing Person,	media about various patterns to crime etc.		
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B. Solid Waste Management

- Household level coverage of municipal solid waste collection
- Efficiency of collection of municipal solid waste
- Extent of municipal solid waste recovered through reuse

Use Case 4: How to improve cleanliness at public places?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to improve cleanliness at public places?	Ability to view the cleanliness, dead animal complaints on city map	Designing shortest route for garbage collection vehicle to aggregation point	Trigger Event as per configured SoPs	Asset and access Control
	Ability to view designated areas and places with high foot falls	Traffic simulation and congestion management for allocating appropriate vehicle	Communication over VMD, PAS and social media for educating citizens	PTZ Camera Control at Transfer stations. Sweeping machines, road sweepers

	Ability to view and locate hawkers in non-designated areas especially pan shops and food stalls.	Co-relate the data from Bin Sensors and other data like seasonal patterns, crowd movement, vehicle breakdown etc.	Two way communication with field force: Sanitation Inspectors, Health Department Officers, and Vehicle drivers.	On Field Resource Mobilisation in real time.
	Ability to view dashboard/trend over compliant status for overflowing bin/litter around bins.	Areas wise analysis of waste or garbage on timelines	Bulk SMS/Notifications to the citizen in locality	Proper routing of vehicles in real times and assistance during vehicle breakdown
	View Attendance compliance report : Area wise	Sentiment Analytics and response wrt to event	Event Summary report using Knowledge Base	

Use Case 5: How to improve Public Toilet facility?

Use Case	Data Acquisition and Visualisation	Data Aggregation and Analytics	Communication	Command and Control
How to improve public toilet facility monitoring and servicing?	Ability to view all public toilets on city map along with meta data (toilet type, water supply, cleanliness etc.)	Ability to view the trend of public toilets usage	Ability to communicate complaints and feedback with contractors, area officer and department heads responsible for maintenance of public toilet.	Ability to allocate the complaint to specific contractor, area officer etc.
	Ability to view the cleanliness schedule of public toilets with meta data (contractor details, time etc.)	Ability to predict the complaints related to public toilets	Ability to provide information to citizens about public toilet through app, SMS and QR code	Ability to send alert on receiving poor feedback or complaint wrt to public toilets.
	Ability to view the citizen feedback of public toilets	Ability to track the area-wise issues pattern (Water leakage, unclean toilets etc.) wrt to public toilets.	Ability to collect feedback from citizens using QR code mechanism	Ability to control the CCTV Camera deployed at public toilet entrance

	Ability to view the complaints of citizens related to public toilets	Ability to do trend analysis of citizen satisfaction rating wrt to public toilets (using mobile app or feedback capture machine)	Ability to use VMD to update citizens about public toilets in given locality and its rating	
	Ability to track and monitor SLA status of complaints related public toilets	Optional : Ability to do usage/revenue analysis (if chargeable) of public toilets	Ability to send complaint status to citizens wrt to public toilets	

Use Case 6: How to manage Solid Waste Management Operations effectively?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to manage Solid Waste Management Operations effectively	Ability to View the bin sensor data	Ability to view the garbage collection trends from areas across the city	Real time reports to officers, contractors and departments on garbage pickup schedule and compliance	Ability to control the cameras at transfer station, processing plant.
	Ability to view the garbage pick-up vehicle schedule and transfer station real time feeds	Ability to predict the chronic garbage spots and assess the patterns	Communication to citizens and NGOs over garbage processed (Wet, Dry , Medical and e-Waste)	Ability to assign Solid Waste pick up vehicle in real time as per requirements

	Ability to view the processing plant real time data feed	Ability to assign shortest pick up route to vehicle and predict garbage vehicle breakdown	Ability to communicate with Vehicle driver, sanitation officer and processing plant manager real time	Ability to control the operations of Transfer station and Processing plant in real time.
	Ability to view and track the sanitation officers attendance and movement	Ability to predict the garbage operation compliance through SLA scorecard and dashboard	Educate citizens through website, mobile app, SMS to reduce garbage generation	Control Household level coverage of municipal solid waste collection

Use Case 7: How to manage on demand waste collection in city?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to manage on-demand waste collection in City?	Ability to receive the complaint of on demand garbage collection through various channels	Ability to view the shortest route to respond the on demand request	Ability to communicate with on field staff/contractor/vehicle driver and citizen	Ability to allocate the request to an officer/contractor/processing plant etc.
	Ability to schedule the waste collection as per waste type (medical Waste, Hazardous Waste or e-Waste)	Ability to predict the waste complaints based on past trends of on demand waste collection requests	Ability to view and update the status of on demand request through call, SMS and WhatsApp	Ability to track the status of vehicle allocated to serve the request.

	Ability to view area wise request and pick up schedule	Ability to predict the cost and effort to calculate the cost wrt to size of request as per business rules.	Ability to communicate the real time status of vehicle to gauge the ETA etc.	Ability to view the SLA compliance and levy penalty on contractor etc.
	Ability to view the request allocation to specific officer and vehicle as per request.	Ability to predict ETA etc.	Ability to increase awareness through bulk SMS, VMD , Website and Mobile app.	

C. Water Supply

Linked Indicators: Livability Index Framework

- Household level coverage of direct water supply connections
- Per capita supply of water
- Quality of water supplied
- Level of Non-Revenue Water (NRW)
- Percentage of water connections covered through meters
- Percentage of plots with rainwater harvesting facility

Use Case 8: How to monitor pressure of water supplied in city?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to monitor pressure of water supplied in city?	View waste water pressure levels and sump levels and across pumping stations and treatment facility with drilldown facility up to a locality	Correlate the complaints and the pressure level data	Communicate with water department to address specific leaks / seepage scenarios	Identify the city areas on GIS map that would require planning of sewer lines and the pumping station
	Identify and view the blockage in the drainage system till the treatment plant	Analyze the consumption data and the patterns in a given locality	Communicate using display devices/bulk sms to inform about traffic	Alert if a specific type of complaint is lodged several times from a particular area through citizens charter
	View complaints reported for sewerage across the city with drilldown facility up to a locality			Alert and shoot message to the concerned personnel in case of threshold breach (water surpasses the threshold.)
	View the status of the complaints/projects with real time monitoring of engineers and work done			Identify the city areas on GIS map that would require planning of sewer lines and the pumping station

Use Case 9: Reduction of potable water wastage in the city?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
Reduction of potable water wastage in the city?	Ability to view the level of storages in reservoirs, dams and water tanks in the city	Level monitoring sensors at Dams, reservoirs, pumping stations/ distribution centres	Trigger event in case of visible pipeline burst	Communication to Response teams based on created alert
	Ability to record and view the trips made by water tankers in various parts of the city	Data collection from Mobile apps given to field officers to monitor wastages and from Citizens in the form of complaints	Automated messaging to citizens in case of water rationing and shortages	Monitoring of discharges through industries in the water sources
	Ability to view the pipeline network and various nodes across the network	Analysis of water consumption per capita for regions in the city along with analysis of reported water wastage data	Regular messages to citizens to create awareness and display of per capita water consumption on VMS everyday	Controlling and monitoring of supply from pumping stations in case of wastage
	Ability to record and view the volume distribution data at a central location	Analysis of water consumption patterns throughout the day and rationing of quantities based on that	Communication Water Ambulance in the vicinity for fixing the wastage by changing taps and monitoring quality of water	Alerts in case of water theft through pipeline and change in pressure
	Ability to record and view the water quality reports	Analysis of water quality at source	Communication/ alert to authorities in case of inadequate volumes at specific nodes	-

D. Emergency and Disaster Management

Use Case 10: Reduction in losses during events of fire break-out?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to reduce human and capital losses in event of Fire break-out?	Ability to view the location of all fire hydrants and tenders across the city	Analysis of unstable, dangerous and fire prone structures in the city	Bulk messaging system for communicating citizens in the vicinity	Creation of emergency corridor/ passage for passing of fire response teams
	Ability to view the heat maps of fire prone areas on the city map based on past incidences and patterns	Correlation with the Environmental, Fire and Temperature sensors	Two way communication between field fire response team and command centre staff	Alerts and communication to Police agencies with appropriate messaging to ensure law and order
	Ability to view the location of hospitals and route with traffic condition in the city on the map	Analysis of number of establishments with appropriate fire safety audits and equipment	Communicating information of current status on VMS and PAS for controlling footfalls in the area	Detection of number of people/ crowd detection in the affected area and communication to nearest Hospital teams for backup
	Ability to view the real time video streaming of the location using the CCTV feed	Analysis of fire events in the industrial and commercial areas for better preparedness	Trigger the event in case of fire incidence for action teams	Auto SOP triggering to utilities such as Piped gas, electricity and telecom for

				discontinuation of services as necessary
	Ability to view the details of fire safety audits performed in the critical areas in the city	Sentiment analysis of the data collected from social media, complaints app and other physical media	Communication for safe exits via PAS for the citizens trapped in affected area	Drones for video surveillance

Use Case 11: How to reduce the damage to property/life in case of Disaster/Emergency event in a busy area of city?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to reduce the damage to property/life in case of Disaster/Emergency event in a	Ability to track Fire Tenders on city map	Designing shortest route for Fire tender and hospitals/fire tender	Trigger Event as per configured SoPs	Asset and access Control
	Ability to view traffic congestion on city map	Traffic simulation and congestion management	Communication over VMD, PAS and social media for regular updates and advisory	PTZ Camera Control
	Ability to view on route camera feeds ,building exit plan	Co-relate the data from (Environment, Fire) Sensors	Two way communication with field force : Police , Traffic Police, Hospitals and City officers	Traffic Signal Control

busy area of city	Ability to locate fire hydrants en-route and in premise	Simulation using 3D Maps of building to support field force	Bulk SMS to citizen in locality	On Field Resource Mobilisation ; Disaster Management Team
	Ability to view nearby Hospitals, Police Stations , Fuel stations, Buildings, public places	Sentiment Analytics and response wrt to event	Event Summary report using Knowledge Base	

E. Service Delivery

Linked Indicators: Livability Index Framework

- Percentage of citizen services available online
- Percentage of services integrated through Command Centre
- Percentage of citizens using online services
- Average delay in grievance redressal
- Tax collected as percentage of tax billed
- Extent of cost recovery (O&M) in water supply services
- Capital spending as percentage of total expenditure
- Percentage of population covered under Ward Committees/Area Sabhas

Use Case 12: How to monitor and manage civic complaints effectively?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to monitor and manage civic complaints effectively	Ability to source civic complaints in real time through various channels : SMS, WhatsApp, Website, Mobile App, Facebook, Twitter, Call Center	Sentiment analysis for data collected from various citizen centric channels such as Social media handles, internet media/ blogs, mobile applications, complaints mail box etc.	Communicate with field staff from the requisite department while addressing complaints (ticket related information). Also Seek feedback from your employees wrt to complainant and problem type .	Alerts to department officers and citizens if higher number of complaints are logged in given time interval.
	Ability to track complaint status and ability to provide update to citizens/officers	Predictive analysis of specific complaint type : Noise, Stench, Stray Dogs, Potholes, Water Quality etc.	Communicate with the complainant through SMS, Social Media , WhatsApp etc to update the Expected time of Allocation and Expected time of Resolution status of the work	Daily alerts for pending grievances along with details of responsible authorities
	Ability to view the SLA compliance status of complaints : Department wise , Officer Wise, Location Wise	Area/ location wise analysis of grievances/ comments for deriving patterns	Communicate using display devices to spread awareness	Alerts in case of non-adherence to SLAs by officers/employees with satisfaction score of each department.

	Ability to view the citizen feedback over the closed complaints through various channels.	Ability to analyse department wise/officer wise SLA compliance and the customer satisfaction on different dimensions	Use digital displays and PIS to spread awareness and taking precautionary measures to reduce the occurrence of civic complaints.	Daily alerts showcasing defaulters with pending tickets.
	Ability to assess the sentiment and key trending issues related to civic issues through online, news and social media platforms.	Root cause analysis of complaints, identify top complaints area wise, department wise etc.	Send SLA details for each process to a citizen / Send alerts to citizens for compliance/ Send reminders to defaulter employees for necessary compliance	Displaying the satisfaction index on VMS and best employees.

Use Case 13: How to gauge Citizen Satisfaction to citizens to improve service delivery?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
Provide sense of satisfaction to citizens while	CCTV at service delivery locations, facilitation centres, offices to get the live feeds of the operations	Sentiment analysis for data collected from various citizen centric channels such as Social media handles, internet media/ blogs, mobile applications, complaints mail box etc.	Communicate with field staff from the requisite department while addressing complaints (ticket related information)	Alerts to response teams in case of any unsettling activities at service delivery locations, facilitation centres, offices

availing services	Ability to view the dashboard of various city administration services and their performance	Predictive analysis while launching / providing any service to the citizens at large	Communicate with the complainant through SMS on the status of the work	Daily alerts for pending grievances along with details of responsible authorities
	Ability to view civic infrastructure assets on map based on their classification and maintenance schedule updates	Area/ location wise analysis of grievances/ comments for deriving patterns	Communicate using display devices to spread awareness on using the citizens charters	Alerts in case of non-adherence to SLAs by service providers
	Ability to view grievance redressal information on the city map with outstanding grievances (utility wise and type wise)	Ability to analyze SLA compliance and the customer satisfaction on different dimensions	In case of an epidemic, use digital displays and PIS to spread awareness and taking precautionary measures	Daily alerts showcasing defaulters with pending revenue
	Ability to view the status of revenue generated through various services along with number of contributors for each revenue source	Analysis of grievance management mechanism for improvement	Send SLA details for each process to a citizen / Send alerts to citizens for compliance/ Send reminders to defaulters for necessary compliance	Displaying the satisfaction index on VMS

F.Civic Health Use Cases

Linked Indicators: Livability Index Framework

- Number of in-patient hospital beds per 10,000 population
- Healthcare professionals per 10,000 population
- Average response time in case of health emergencies
- Period prevalence of water borne diseases
- Period prevalence of vector borne diseases

Use Case 14: How to effectively tackle mosquito borne diseases in city?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to effectively tackle mosquito borne diseases in city	Ability to view patients footfall in real time	Trend analytics of patients footfalls on timeline dimensions	Trigger Event as per configured SoPs	On Field Resource Mobilisation : Sanitation Inspectors allocation and tracking
	Ability to view hospitals and staff/beds/medicine availability in real time.	City wide Hot-Spot Analysis based on lab reports.	Communication over VMD, PAS and social media for regular updates and advisory through city health department	On Field Resource Mobilisation : Fumigation plan based on evidences
	Ability to view fumigation plan and schedule in real time	Co-relate the data from seasonal changes, fumigation activity and impact on disease	Two way communication with field force : Hospitals and City Health and Sanitation officers	

	Ability to locate water logging/potential mosquito breeding cases across cities	Sentiment Analytics and response wrt to event	Bulk SMS to citizen in locality to educate and control vector borne diseases. Event Summary report using Knowledge Base	Trigger alert to Hospitals Emergency room
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Use Case 15: How to strengthen Civic Health Care delivery in the City using Data Analytics ?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
	Ability to view the data of Vaccination Drive on city map	Ability to correlate cause like the impact of water quality, air quality, stress on diseases reported at primary, secondary and tertiary care.	Ability to communicate with patients about medicine /vaccination drive or camps	Ability to coordinate with Hospitals, Labs and on-field staff in real time using handheld devices etc.
	Ability to map in patients at all levels of public hospitals on city map	Ability to do the predictive analytics over the past data to predict the outbreak of disease in community	Ability to communicate targeted intervention with on field/ mobile healthcare staff in real time.	Ability to coordinate with Hospitals and lab to act in case of food poisoning, communicable diseases, industrial accident as per standard protocols

How to strengthen Civic Health Care delivery in the City using Data Analytics?	Ability to map footfalls of citizens at primary, secondary and tertiary care centre for IPD/OPD , major and minor treatment etc.	Ability to view heat-map of different diseases on different dimensions over city maps	Ability to communicate health updates with Health officers, hospitals and labs.	
	Ability to collect data from various health care survey agencies in the city	Ability to identify common diseases based on patient data etc. on daily, weekly and monthly basis to gauge the impact of preventive care program	Awareness drive for citizens in targeted areas through email, SMS, WhatsApp , VMD etc as per preventive healthcare SoPs	Ability to coordinate with Sanitation Department and other line department to take corrective action.

Use Case 16: How to predict Stray Dog menace in the City?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to contain stray dog	Ability to view the dog bites incidents on the city map	Generate Heat-map on city map using the dog bites cases over various dimensions	Ability to inform stray dog team on receiving dog bite complaints	Review the thresholds of dog bites incidents every monthly against reported cases

menace in the City?	Ability to map the data from sterilization drive of stray dogs by department in different parts of the city	Predictive Analytics for over trends of stray dog menace incidents over various dimensions.	To increase awareness among citizens about dog bites and its treatment using SMS, WhatsApp, Website and mobile app	Coordination with Hospitals emergency staff for medical treatment
	Ability to mark sensitive zones where dogs menace is reported by citizens		Encourage citizens to report potential cases of dog menace in locality	

Use Case 17: How to reduce victim transit time from accident location to Hospital?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
	Ability to view the data from mobile healthcare units	Trend analysis of accident zones based on heat map and ensuring readiness	Ability to send targeted alert notifications to officers, on field staff,	Ability to design shortest route for Ambulances/medical vehicles

How to reduce victim transit time from accident location to Hospitals?	View availability of beds, doctors and paramedics in real time across public and private hospitals	Sentiment Analytics and response wrt to event	hospitals and labs in case of emergency.	Ability to deploy assets and manpower as per dynamic requirements
	View availability of medicine and medical stock in real time		Ability to disseminate information/content to patients, citizens about bed availability, availability of doctors/medicines etc.	
	View patient footfalls at primary dispensaries /secondary and specialized hospitals in real time	Traffic simulation and congestion management		Voice Communication to provide personal assistance to stakeholders
	View traffic congestion on city map			

G. Street Light

Linked Indicators: Livability Index Framework

- Percentage of households with authorized electrical service
- Percentage of electrical connections covered through smart meters
- Average number of electrical interruptions per year
- Average length of electrical interruptions per year
- Percentage of total energy derived from renewable sources
- Energy consumption per unit - water supply and sewerage
- Energy consumption per unit - street lighting
- Percentage of new and redeveloped buildings following green building norms
- Total energy consumption per capita

Use Case 18: How to monitor and maintain street lighting networks remotely

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to monitor and maintain street lighting	Light On/off as per pre-set ambient condition	Analyze trends over dashboard for Street Light Maintenance Dashboard.	Notifications to the citizens	View street lights, controller and feeder on the city map
	Light Intensity /Luminosity - auto increase/ dimming as per ambient conditions	Prediction of Optimum Light Intensity based on Ambient Light and Sensor Data		

networks remotely	Power saving mode - When there is no changes in environment and during night time, dimming the lights (reduce luminosity) and switch off alternate lights.	Predictive maintenance alerts		
	Light On/off as per pre-set ambient condition			

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H. Transit and Mobility Use Cases

Linked Indicators: Livability Index Framework

- Geographical coverage of public transport
- Availability of public transport
- Mode share of public transport
- Percentage of road network with dedicated bicycle tracks
- Percentage of interchanges with bicycle parking facilities
- Mode share of non-motorized transport
- Availability of Passenger Information System
- Extent of signal synchronization
- Availability of paid parking spaces
- Percentage coverage of footpaths – wider than 1.2 m
- Percentage of traffic intersections with pedestrian crossing facilities
- Extent to which universal accessibility is incorporated in public rights-of-way

Use Case 19: How to manage the City Bus Operations effectively?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to manage the City Bus	View real time information about buses location, traffic flow, congestion of buses, peak and non-peak time information	Analyze the buses density on a particular route and updating the same on real time basis on traffic flows and utilization of buses	Sharing the information with the passengers about the route delay through Mobile app notifications and PIS Display	Suggest alternate routes to the drivers through 2 way communications. Also make decision to perform route scheduling

Operations effectively?	Calculating the Run Km and Dead Km through GPS for the payment of Bus Operator	Analyzing the Km cloaked by the Buses in respect with the trip scheduled and operated	Sent alert to the operators about the Km cloaked by the buses in respect with no of trips operated	Comparing the GPS Run Km and Dead Km data with the audited data and clearing out the discrepancies
	Monitoring the incidents occurred such as route violation, skip stops, harsh driving, sharp cornering	Analyze the trends in the incidents occurred through Incident Management System	Automatic alerts to the operators and the agency regarding the generated incident and TAT for resolving the same	Calculating the penalty for the incidents and imposing it on the operators

Use Case 20: How to do City Traffic Planning using Data Analytics?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to do City Traffic Planning using	View Traffic Volumes, Peak time, Flows and Vehicle Type across different cross roads/ Junctions of the city through ANPR system	Analyze the traffic volume and peak time data to identify the Cross roads/Junctions for zero tolerance for traffic violations, Infrastructure health (Roads, Traffic signal etc.)	Share real-time traffic congestion route through VMD's radio Services etc.	Suggest alternate routes to commuters, take corrective/repair activities for road infrastructure and make decisions to widen the roads for smoother traffic flow

Data Analytics?	View Traffic Signal controls and health status	Analyze the trend of the faults in the Traffic signals for identifying the root cause of the repeat failure and also plan a preventive maintenance schedule	Sent alerts through SMS and Whats app to the concerned staff and office	Monitor the Health and take corrective/preventive maintenance of the Traffic infrastructure
	View the Traffic Trend on city map for different time zones of the day	Analyze and co relate the Traffic flow and trend on city map for assisting the emergency services like fire tender's , ambulances etc.	Assist the driver of the vehicle through mobile application/ phone line	Identify the shortest and less crowded route for Ambulances/Fire/ Police vehicles
	View Traffic violations and accidents patterns on city map though camera system	Analyze the cases of traffic violations (types and no.) and accidents on city map to take serious action against offenders and control the accident rate	Send SMS based warnings and alerts to the repeat violators	Improve enforcement and vigil at such locations to reduce the accident and violation rate

Use Case 21: How to identify open parking spots in City?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to identify	Identify location, number, functional/nonfunctional	Total exceptions in the day/week/month and possible cause	Notifications to the citizens	View Hotlisted/ watch listed vehicle list

open parking spots in City?	Parking Slots on city map	Mapping of the city traffic , footfall with parking data for future planning		View real time meta data from cameras, sensors
	Identify location and number of Parking Slots on mobile app with payment gateway option	Analyze traffic patterns and parking at key locations for planning and operations purposes.		Show Revenue Collections by each Parking Facility
		Public parking slot-space availability prediction	Auto ticket generation for faulty camera / other assets	
		Expected waiting time for next parking availability		
		Parking space availability predictions based on traffic conditions and events happening in that area		

Use Case 22: How to monitor entry of vehicles to restricted Zones?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to monitor entry of vehicles to restricted Zones?	View real time meta data from cameras	Trend analysis based on heat map	Action taken/ resolution report in coordination with RTO	On Field Resource Mobilization in real time
	View real time traffic movement in designated areas	Suspect person/ Proclaimed offenders/absconders (Offender's Pattern Matching - real time)		
	View Hot listed/ watch listed vehicle list	Planning/ forecasting manpower required for surveillance in high risk area.		
	Complaint management thru citizen mobile app	Traffic flow optimization through major intersections and adjacent area		

I. Roads Management

Use Case 23: How to reduce citizen inconvenience during road maintenance?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to reduce citizen inconvenience during road maintenance	View status of on-going roads projects across the city with drilldown facility up to a locality	Ability to do the prescriptive analysis for road engineers to show the priority of road /road asset maintenance in allocated budget	Communicate with field staff from roads (engineering) department while addressing complaints (ticket related information)	Alert if a specific type of complaint is lodged several times from a particular area through citizens charter
	View the status of the complaints/projects with real time monitoring of engineers and work done	Ability to view the road potholes in different areas using area wise past trends	Communicate with field staff from other utility departments (water, sewerage, telecom,gas) for permissions to dig roads and co-ordinating re-surfacing activities	Identify the city areas on GIS map that would require planning of roads, road widening and footpaths in the future
	View the underground utility network on the map for installations and maintenance work	Ability to correlate the potholes complaints with road maintenance schedule and defect liability period.	Communicate about roads reparation through display devices to divert traffic	
	Ability to view the ongoing work for maintenance with meta data (Contractor,			

	duration, material, responsible officer)			
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Use Case 24: How to effectively tackle potholes problems in City?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to effectively tackle potholes problems in City?	Ability to view potholes (with photos and videos) complaints logged by citizens	Trend analysis of Potholes complaints	Trigger Event as per configured SoPs.	On Field Resource Mobilisation : Sanitation Inspectors allocation and tracking
	Ability to view the dashboard of potholes based on status.	City wide Hot-Spot Analysis based on potholes	Allocation of potholes through Mobile app to contractors and Road Engineers.	Trigger alert to concerned Engineer
	Ability to view and track roads on city map	Co-relate the data from seasonal changes and budget spent on maintenance	Two way communication with field force to assist in field operations	Manage Traffic Diversions in real time
	Ability to view the road meta data like contractor data, maintenance data, materials etc.	Sentiment Analytics and response wrt to event	Communicate to citizens/community in locality etc. share the closure	NoC to be obtained for Road Maintenance

	Ability to view road maintenance schedule/plan of roads department	Aging Report of potholes and road construction and maintenance	Event Summary report using Knowledge Base	
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J. Waste Water Treatment

Linked Indicators: Livability Index Framework

- Coverage of toilets
- Coverage of sewerage network
- Collection efficiency of sewerage network
- Extent of reuse and recycling of waste water
- Coverage of storm water drains

Use Case 25: How to control affluent disposal into city water bodies?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
	View complaints reported from citizens	Identify the distribution of industrial areas across the city and their proximity to river areas	Communicate with water department to address issues	Control parameters and set thresholds for alerts at various location across the river

How to control affluent disposal into water bodies?	Monitor the levels of pH and other chemical composition of water	Ability to view area wise water composition patters and derive insights	Communicate using display devices to inform about specific water conditions (shortage, purity levels, special instructions) or awareness messages about water conservancy to citizens at large	Alert and shoot message to the concerned personnel in case of threshold breach (water surpasses the threshold.)
	View water level at reservoirs across the city with drilldown facility up to a reservoir	Ability to analyze waste dispense and identify patterns in given area in given season.	Communicate with field staff from fire department to provide overhead tank status while addressing exigencies	
	View the underground utility network on the map.	Analyze the diseases reported due to water contamination		
	View if flooding of waste into water bodies through CCTV			

Use Case 26: How to ensure the storm water network readiness before rains?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to ensure the storm water network readiness before rains?	Ability to view the storm water network (along with meta data like capacity, maintenance due etc.) on city Map /GIS	Ability to simulate the water flow in different scenarios across storm water network	Communicate with Drainage department officers and contractors regarding overflowing drainage	Monitor the SLA compliance of contractor and officers wrt of maintenance of drainage network
	Ability to view Storm water drainage network cleanliness schedule and progress of cleanliness plan along with details of concerned officers and contractors.	Predictive analytics based on complaints and cleanliness schedule.	Communication to citizens through website, mobile app, SMS, WhatsApp to update them about maintenance drive	Ability to control the Cameras and sensors of water treatment plant and vehicles
	Ability to view the area wise budgetary provision of each area for cleanliness of storm water	What-If analysis to check the readiness of water network to manage the flow over GIS.	Communicate the lab reports of water treatment plant outputs	

K. Environment

Linked Indicators: Livability Index Framework

- Concentration of SO₂ - air pollution
- Concentration of NO₂ - air pollution
- Concentration of PM₁₀ - air pollution
- Level of noise pollution
- Quality of water in public surface water bodies

Use Case 27: How to address air and noise pollution in city using environmental Sensors?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
How to address air and noise pollution in city using Environmental Sensors?	Ability to view Air Quality Index across city, levels of various constituents (CO, CO ₂ ,SO ₂ ,NO ₂ , PM ₁₀) etc.	Ability to correlate the data emanating from various Environmental sensors in different areas of city wrt to city mobility/traffic	Ability to communicate the levels of AQI and Noise in locality to citizens, businesses and industry on daily basis	Monitoring the AQI in real time and coordinating with Traffic Police and Environment Department.
	Ability to view the hotspots across various areas in city where high noise cases are reported by citizens	Ability to predict the poor quality of air and water with complaints received through various channels	Ability to send the aggregated data of AQI and Noise to concerned authority to address the problems through policy.	Ability to address the noise issue by issuing advisory to local businesses, marriage gardens etc.

	Ability to view visibility in different part of city	Ability to predict the poor quality of air and water on various dimensions like timelines, seasons where there is high density of markets, industry or shops.	Ability to spread awareness at chronic location/spots identified over VMD, website, mobile app, WhatsApp etc.	Allocating and monitoring noise complaint to the on-field squad to take intervention as per defined SoPs.
	Ability to Permissible limits of Noise levels in various areas across the city	Ability to view the heat-map of noise pollution over different dimensions	Ability to educate the masses using bulk SMS, email and messages about best practices	

Use Case 28: How to increase the green cover of the City?

Use Case	Data Acquisition and Visualisation	Data Collection and Analytics	Communication	Command and Control
	Ability to view the green cover on city map along with meta data (tree type, tree health, tree location, age)	Ability to assess the quality of green cover across the city	Ability to communicate the schedule for Tree trimming/cutting in real time to residents	Ability to coordinate with tree trimming/cutting team in real time.

How to increase the green cover of the City?	Ability to view the request of tree cutting/trimming in real time	Generate area wise insights about flora and fauna of each area and its health	Increase awareness through bulk SMS, Bulk Email about the flora and fauna of the city.	Ability to respond to illegal tree cutting as per SoPs
	Ability to mark the areas with low/medium/high density tree cover	Ability to view the tree cover on interactive GIS map.	Increase Awareness about various tree plantation initiatives to preserve flora and fauna in locality.	Ability to review the SLAs as per citizen charter of contractors/officers for managing
	Ability to view the locations and schedule of tree trimming/cutting squad in real time.		Ability to coordinate with key NGOs and environment activist group over the activities like tree plantation and trimming/cutting exercise.	

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